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THESIS

MEASURING SUCCESS: METRICS THAT LINK SUPPLY CHAIN MANAGEMENT TO AIRCRAFT READINESS

by

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September 2002

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MEASURING SUCCESS: METRICS THAT LINK SUPPLY CHAIN MANAGEMENT TO AIRCRAFT READINESS

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ABSTRACT

This thesis evaluates and analyzes current strategic management planning methods that develop performance metrics linking supply chain management to aircraft readiness. Our primary focus is the Marine Aviation Logistics Squadron. Utilizing the Logistics Management Institute's *DoD Supply Chain Implementation Guide* and adapted SCOR model, we applied the six step process for developing a strategic logistics management plan for implementing supply chain management for use at the MALS, and subsequently defined the interdependencies of the Naval/Marine Corps Aviation Logistics Supply Chain. The Theory of Constraints proved to be a viable tool for establishing aircraft readiness as the ultimate goal of Marine Corps aviation logistics, and provided a means for identifying and eliminating readiness constraints preventing the MALS from achieving its goal. MALS-14's successful implementation of a structured planning and feedback system based on the Theory of Constraints justifies the need for MALS strategic logistics management planning and supply chain management. Effective process-oriented performance metrics are not only critical for achieving a fully integrated supply chain, but also link supply chain management to the common goal of aircraft readiness, provide the means for measuring supply chain performance improvements, identify readiness degraders, and elicit behavior from aviation logisticians to improve aircraft readiness.

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LIST OF ACRONYMS

A_o	Operational Availability
ACE	Air Combat Element
ALT	Administrative Lead Time
AMO	Aviation Maintenance Officer
ASL	Aviation Logistics Support Branch
ASO	Aviation Supply Officer
ATAC	Advanced Traceability and Control
AVLOG	Aviation Logistics
AWM	Awaiting Maintenance
AWP	Awaiting Parts
BCM	Beyond Capability of Maintenance
CDB	Consumable Delivery Branch
CMD	Consumable Management Division
CO	Commanding Officer
CPI	Cost Price Index
CRT	Current Reality Tree
CWT	Customer Wait Time
DDD	Defense Distribution Depot
DIFM	Due in from Maintenance
DLA	Defense Logistics Agency
DoD	Department of Defense
DTO	Direct Turnover
EIS	Executive Information System
ERP	Enterprise Resource Planning
FISC	Fleet and Industrial Supply Center
FLR	Field-level Repairable
FMC	Full Mission Capable
FRT	Future Reality Tree
ICP	Inventory Control Point

IDTC	Inter-deployment Training Cycle
IMA	Intermediate Maintenance Activity
INMARSAT	International Maritime Satellite
LMI	Logistics Management Institute
LRT	Logistics Response Time
MALS	Marine Aviation Logistics Squadron
MAG	Marine Aircraft Group
MAW	Marine Aircraft Wing
MCDP	Marine Corps Doctrinal Publication
MCWP	Marine Corps Warfighting Publication
MIS	Management Information System
MTW	Major Theater War
NADEP	Naval Aviation Depot
NALCOMIS	Naval Aviation Logistics Command Management Information System
NAVAIR	Naval Air Systems Command
NAVICP	Navy Inventory Control Point
NAVRIIP	Naval Aviation Readiness Integrated Improvement Program
NAVSUP	Navy Supply Systems Command
NMC	Not Mission Capable
OMA	Organizational Maintenance Activity
PFD	Process Flow Diagram
PLT	Production Lead Time
PMC	Partial Mission Capable
POA&M	Plan of Action and Milestones
POE	Point of Entry
RCT	Repair Cycle Time
RDB	Repairable Delivery Branch
RDD	Required Delivery Date

RMD	Repairable Management Division
SALTS	Streamlines Alternative Logistics Transmission System
SCM	Supply Chain Management
SMART	Supply Maintenance Aviation Reengineering Team
SOA	Supply Officer Asset
SRD	Supply Response Division
SUADPS-RT	Shipboard Uniform Automated Processing System – Real Time
TAT	Turnaround Time
TOC	Theory of Constraints
UMMIPS	Uniform Material Movement and Issue Priority System
WIP	Work-in-Process
WRA	Weapons Replaceable Assembly

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I. INTRODUCTION

Tactical AVLOG involves the coordination of functions required to sustain and move aviation squadrons, personnel, equipment and supplies. These functions must deliver flexible and responsive AVLOG to meet the needs of the forces engaged in operations. Therefore, the response time of tactical AVLOG must be flexible and capable of expeditious deployment and therefore requires anticipatory planning to provide this type of support (MCWP 3-21.2, pg. 1004)

A. BACKGROUND

The *DoD Logistics Strategic Plan* provides top-level guidance toward a joint logistics infrastructure that focuses on Supply Chain Management. The plan outlines the mission, vision, end-state characteristics, critical success factors, and logistics objectives and measures to support a joint integrated supply chain (see Appendix A).

As the joint logistics concept continues to be developed and implemented, each service must strive to develop service oriented Strategic Logistics Plans that not only support service specific roles and missions but also fall within the scope of the *DoD Logistics Strategic Plan* in order to provide joint, seamless supply chain support to any unit anywhere in the World.

To meet the requirements of the *DoD Logistics Strategic Plan* and to provide the "precision logistics" required by the Air Combat Element (ACE) throughout the full spectrum of conflict, Marine Corps Aviation Logistics must transform into a more responsive force for the 21st century. Marine Corps Doctrinal Publication (MCDP) 4, outlines four challenges facing logisticians: (1) logistics must enhance, not inhibit, operational designs, (2) logistics systems must anticipate requirements, (3) logistics systems must be flexible, and (4) logistics systems must be effective yet efficient. [Ref. 1:p. 81] In order to address each of these challenges, Marine Corps Aviation Logistics must embrace new ways of doing business without sacrificing combat effectiveness for logistics efficiency.

To embrace new ways of doing business requires change or transformation. This transformation forces us to answer three basic questions: (1) What to change, (2) What to change to, and (3) How to cause the change? More importantly, the transformation to supply chain management requires us to think strategically and systematically and focus

the entire supply chain toward one objective – operational availability of weapons systems.

In 2001 Marine Aviation logistics Squadron (MALS) 14, developed and implemented a strategic management plan based on the Theory of Constraints. The strategic plan that MALS-14 implemented to improve aircraft readiness and logistics responsiveness with Marine Aircraft Group (MAG) 14 is extremely similar to the principles of supply chain management (SCM) and the SCM implementation recommendations of the Logistics Management Institute's *DoD Supply Chain Management Implementation Guide*.

As the Marine Corps' tactical aviation logistics organization, The MALS is the "retail" component of the DoN/MC Aviation Logistics Supply Chain. The MALS is responsible for providing intermediate-level maintenance, supply, and ordnance/armament support for aircraft and aeronautical equipment. Each MALS is organized to provide a core group of supervisory and support personnel that, when augmented by aircraft-specific maintenance personnel from aircraft squadrons, provides an intermediate maintenance capability for either fixed or rotary-wing aircraft. [Ref. 2: p.1005]

To break from common practice requires courage. Typically, aviation logisticians strive to ensure that their organizations remain busy and efficient. Yet, as crisis responders, we are accustomed to crisis planning. In turn, resources are thrown at the problem as a means to resolve a situation. This method of problem solving and pursuit of efficiency not only builds pockets of excellence, but often prevents a unit from effectively accomplishing its goal.

The goal of the MALS is to sustain weapon system availability – aircraft readiness. However, current management practices and supporting information technology and metrics do not support this aim. Colonel Eck, Assistant Branch Head for the Aviation Logistics Support Branch (ASL), states that "in the Marine Corps and in the MALS aiming to achieve efficiencies is what we have done well in the past, what we expect in the future, and how we continue to measure how successful we are." By

focusing solely on efficiencies and optimizing resources in every area, we have failed to maximize the overall effectiveness of the MALS.

Current polices and practices aviation logistics uses to measure aircraft readiness do not accurately display how to effect positive change and prevent problems before they happen. Furthermore, traditional metrics reinforce local efficiency behavior. In fact, many of the traditional metrics used to measure the success of a MALS may not result in a MALS performing and contributing to aircraft readiness, and some metrics could even be detracting from optimizing aircraft readiness.

For example, turnaround time (TAT), beyond capability of maintenance (BCM) rates, and supply effectiveness are current MALS performance metrics that have no apparent correlation to aircraft readiness. These internal efficiency metrics lead us to "operate on the assumption that maximizing the performance of each component part of the system will automatically maximize the performance of the system as a whole". [Ref. 3: p.6]

Effective performance metrics are not only critical to achieving a fully integrated supply chain but also to measuring the performance of supply chain improvements. The current trend in supply chain management is toward enterprise resource planning (ERP) which requires a shift from individual functional area metrics to process metrics. For these process metrics to be effective managerial tools to improve aircraft readiness, the metrics must (1) be more strategic, (2) provide insight, (3) be included in the process, (4) be goal-based, (5) identify trends, (6) identify drivers to aircraft readiness, and (7) illicit behavior from aviation logisticians that lead to improvements in aircraft readiness. Thus, without performance metrics that link supply chain management to aircraft readiness, how do we determine the successful implementation of supply chain management initiatives throughout DoD?

B. OBJECTIVE

The objectives of our thesis are (1) to develop a SCOR Model of the DoN/MC Aviation Logistics Supply Chain, (2) to conduct a case study of the MALS-14 Strategic Management Plan and (3) to develop performance metrics to manage primary readiness degraders and to improve logistics response time through a structured planning and feedback system based on the Theory of Constraints.

C. RESEARCH QUESTIONS

Primary Research Question: How are performance metrics established for a Marine Aviation Logistics Squadron (MALS)? How are these metrics utilized to manage primary degraders to aircraft readiness?

Subsidiary Research Questions:

1. What is the global goal for Aviation Logistics?
2. What are primary degraders?
3. What is the DoN/MC supply chain relative to a MALS?
4. Does the Theory of Constraints Philosophy provide a framework for identifying primary degraders?
5. What was the structured planning and feedback system utilized by MALS-14?

D. SCOPE, LIMITATIONS, AND ASSUMPTIONS

The scope of our thesis is the development and implementation of a strategic management plan for supply chain management. First, we adopt the SCOR model to map the DoN/MC Supply Chain for Aviation Logistics. It is our assessment that an understanding of the overall integrated supply chain is required prior to the analysis of any individual functional area within the supply chain.

Second, we view the integrated supply chain as a system composed of interdependent parts. Thus, we limit our case study analysis to MALS-14's development and implementation of a strategic management plan for improving aircraft readiness within MAG-14.

Third, because weapons system programs are different, the supply chain for each weapon system is unique. Therefore, each organization must develop and implement a strategic management plan with respect to the weapons system and the supporting supply chain. However, we emphatically believe that weapon system availability should be the global goal for the integrated supply chain.

E. ORGANIZATION OF THESIS

Chapter II will provide an analysis of the DoN/MC supply chain using the SCOR method, as well as show how aircraft readiness should be the global goal for supply chain management. Chapter III will provide the background for using the Theory of Constraints for identifying readiness degraders. Chapter IV will analyze MALS-14's Strategic Management Plan with respect to the guiding principles of the DoD Supply Chain Management Implementation guide and the Theory of Constraints. Chapter V will provide background information on developing performance metrics that link supply chain management to aircraft readiness. Chapter VI will provide a summary, conclusions, and recommendations.

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II. SUPPLY CHAIN MANAGEMENT AND THE MALS

A. OVERVIEW

The basis of this chapter is first to establish a baseline for understanding the Marine Corps' aviation logistics infrastructure and support pipeline from a supply chain management perspective. Second, this chapter will provide the structural framework for developing the performance measures and outline for a strategic logistics management plan for improving Marine aviation logistics at the strategic and tactical level. The information contained in this chapter will serve as a reference point and add value and justification for the case study analysis of Marine Aviation Logistics Squadron 14's implementation of a "structured planning and feedback system" based on the management philosophy of the "Theory of Constraints." It is our opinion that the strategic plan that MALS-14 implemented to improve aircraft readiness and logistics responsiveness with Marine Aircraft Group 14 (based on Theory of Constraints management) is extremely similar to the principles of supply chain management (SCM) and the SCM implementation recommendations of the Logistics Management Institute's *DoD Supply Chain Management Implementation Guide*, referred to hereafter as "*The Guide." The Guide* and most literature regarding SCM asserts that application of supply chain management must be implemented from end-to-end within the entire supply and logistics process enterprise and that "true" SCM can only be accomplished within this framework. Based on this assumption, "true" SCM cannot be partially implemented within a functional segment of the Naval/Marine aviation logistics infrastructure (e.g., the Marine Aviation Logistics Squadron). We propose that strategic logistics planning based on SCM principles can still be applied within the Marine Aircraft Group and Marine Aviation Logistics Squadron in order to 1) improve current and future aviation logistics support and aircraft readiness where required, 2) help prepare the for the eventual implementation of SCM within Naval/Marine aviation logistics, and 3) once SCM is implemented, serve as the overarching logistics strategy to integrate all Naval/Marine Corps aviation logistics supply chain activities' performance metrics towards a common goal: aircraft readiness or operational availability (A_o). With this in mind, the main

objectives of this chapter are to review and analyze *The Guide's* six step process for implementing SCM in defense department organizations and its relevancy to Naval/Marine Corps aviation logistics and the Marine Aviation Logistics Squadron, develop a high-level graphical model in order to map the complex Naval/Marine Corps aviation logistics supply chain network, and utilizing the Supply Chain Operations Reference (SCOR) model, adapt SCOR model process flow diagram describing the tactical aviation logistics operations of the Naval/Marine Corps aviation logistics supply chain segment most closely linked to aircraft readiness (operational availability or A_o) and logistics responsiveness outside of the individual flying squadron: the Marine Aviation Logistics Squadron (MALS).

Two textbooks that provide guidance and recommendations on adapting and implementing SCM within the Department of Defense are: "*Supply Chain Management: A Recommended Performance Measurement Scorecard*," and the "*DoD Supply Chain Management Implementation Guide*" (or "*The Guide"* for short) both by the Logistics Management Institute. Both texts also provide detailed methods for measuring and managing performance within the supply chain. In order to measure performance of the MALS with respect to aircraft readiness, it is imperative to develop a strategic management plan first. These two books, as well as the efforts of all the services within the Department of Defense implementing logistics reform (the Air Force's Agile Logistics initiative, the Navy's Expeditionary and High Yield Logistics initiatives, the Army's Velocity Management initiative, and the Marine Corps' Precision Logistics and Integrated Logistics Capability initiatives), prove that ***supply chain management is a critical underlying strategy for developing a successful strategic logistics management plan and performance measures that are intimately tied to achieving the ultimate goal of any logistics organization: optimizing a weapon system's readiness/operational availability (A_o). In the case of Marine aviation, the ultimate goal is aircraft readiness (A_o).***

B. SIX PILLARS OF SUPPLY CHAIN SUCCESS

The Guide was developed to serve as a "cookbook" for implementing supply chain management within the Department of Defense to "assist DoD logistics personnel at all organizational levels who want to improve material support and service to customers." [Ref. 1:p. vii] *The Guide* provides adaptations of commercial best business practices in supply chain management for application in defense logistics founded on six principal pillars of success elements: (Ref. 4:p. 5)

- Determination of guiding ***principles*** to focus and validate required actions
- Establishment of a team-based, coordinated ***organizational structure*** to complete or oversee required implementation actions
- Development, publication, and management approval of a comprehensive ***implementation strategy***
- Identification and implementation of selected applicable ***best business practices*** to support DoD transition to the supply chain concept
- Identification and application of enabling methods and ***technologies***
- Management of the future process through enterprise-wide ***performance measures***

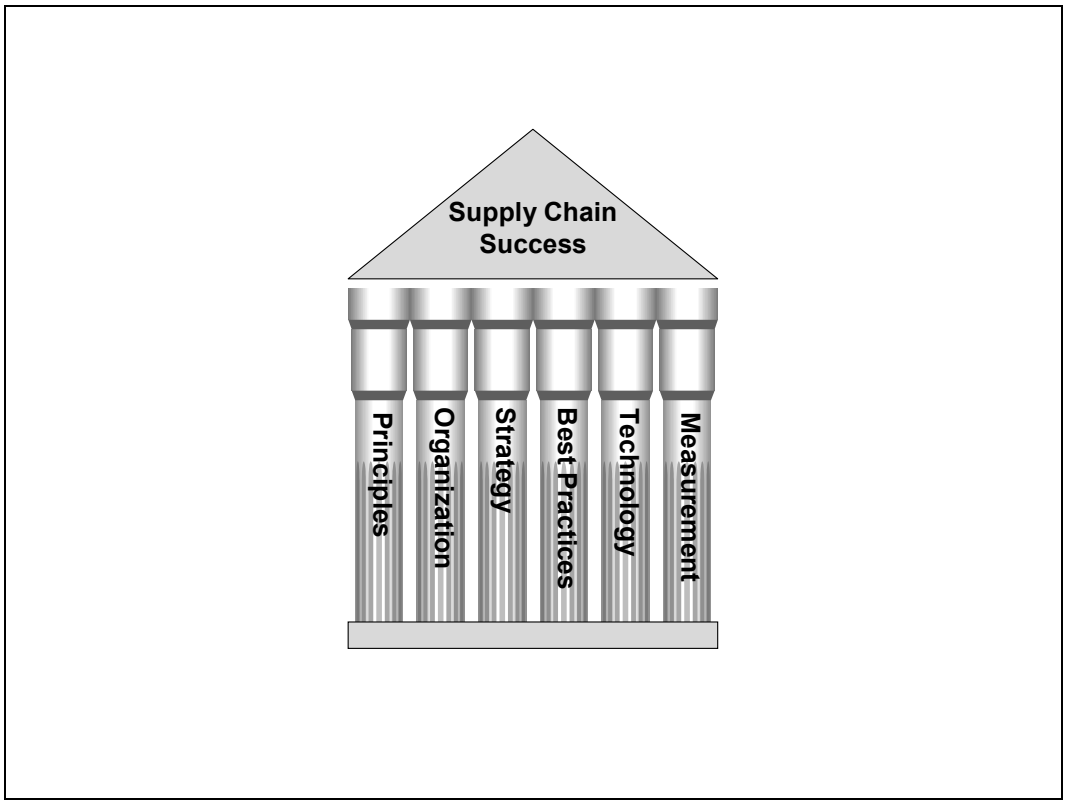

Figure 2- 1 Pillars of Successful Elements [From Logistics Management Institute, 2000]

The "six pillars of successful elements" (Figure 2-1) are necessary to accomplish a successful transition from a traditional multi-functional logistics and supply organizational structure to an integrated, cross-functional supply chain management organizational structure. [Ref. 4:p. 6] These elements ultimately provide the foundation for the organization's strategic logistics management plan, and development of performance measures through a six step process described in detail in *The Guide*. Further in this thesis we will perform a case study analysis of Marine Aviation Logistics Squadron 14's (MALS-14) successful implementation of a tactical-level strategic logistics management plan based on the philosophy of the "Theory of Constraints" which drastically improved aircraft readiness and logistics responsiveness within Marine Aircraft Group 14 (MAG-14). Although MALS-14 did not intend to implement SCM, their "structured planning and feedback system" strategic logistics management plan is

comparable to *The Guide's* six step process of SCM implementation. An integral part of the MALS-14 case study in chapter 4 will be comparing this six step process of SCM implementation with the MALS-14 strategic logistics management plan. What follows is a description of the principles of SCM and an overview of the six step process for implementing SCM in a defense environment.

C. PRINCIPLES OF SUPPLY CHAIN MANAGEMENT

The *2000 DoD Logistics Strategic Plan* defines the logistics mission as follows: "To provide responsive and cost-effective support to ensure readiness and sustainability for the total force across the spectrum of military operations." [Ref. 5:p. 10] Despite the fact that this defense-peculiar definition of logistics has not changed in recent history, Naval/Marine aviation logistics doctrine and strategies for accomplishing the logistics mission changed dramatically in recent history due to events such as the end of the cold war, new and emerging threats, increased global operational tempo, quadrennial defense reviews and force draw-downs, and the sequential decline of the defense budget. This same document also provided the vision for the future of DoD logistics: "By 2010, the logistics process will be an efficient, integrated supply chain of private sector and organic providers that ensures full customer-oriented support to personnel and weapons systems." [Ref. 5:p. 12] The DoD definition of supply chain management as proposed in *The Guide* is as follows: [Ref. 1:p. 14]

> DoD supply chain management is an integrated process that begins with planning the acquisition of customer-driven requirements for material and services and ends with the delivery of material to the operational customer, including the material returns segment of the process and the flow of required information in both directions among suppliers, logistics managers, and customers.

The essence of the supply chain management concept is the "continuous, unbroken, comprehensive, and all-inclusive logistics process, from initial customer order for material or services to the ultimate satisfaction of the customer requirement." [Ref. 4:p. 13-14]

The Guide warns against defense logistics managers falsely assuming the pre-existing logistics infrastructure is comparable to a fully integrated supply chain because

of the relationships between inventory control and wholesale stock points, maintenance depots, distribution activities, retail-level supply and maintenance activities, and end-user customers. Another false assumption is that large scale technology insertion can provide integrated SCM and result in streamlining, modernizing, and speeding up current logistics functions. These two critical mistakes results in failure to reap the full benefits of "true" SCM implementation experienced by best business practices (long term increased performance, end-to-end integration of logistics effort, and cost savings). [Ref. 4:p. 12-13] Although *The Guide* emphatically states, "Implementation of SCM in the DoD cannot focus solely on individual functions within an organization but must rather concentrate on the end-to-end process of ensuring the warfighting and other operational requirements are consistently satisfied at the point of need," our study intends to leverage the principles of SCM in focusing on improving tactical-level Marine aviation logistics support until supply chain management is eventually implemented throughout the Navy/Marine Corps supply and logistics enterprise. [Ref. 4:p. 15]

The fundamental principles of SCM serve as the foundation for change and integration not only within the functional organization, but the enterprise as a whole. Prior to implementing any strategic logistics management plan or reforms based on supply chain management, it is important to understand the basics of supply chain management principles. *The Guide* provides twelve adapted principles for DoD SCM based on industry standards and practices. These principles are founded on "satisfying the logistics support requirements of the military operating forces and, as a corollary, making the best use of available personnel, financial, and infrastructure resources." [Ref. 4:p. 18] They are: [Ref. 4:p. 18]

- Structure logistics procedures and systems to provide an agile response during crisis and joint operations
- Focus on satisfying warfighter requirements at the point of need
- Link customers directly to the source of material and services support

- Balance the use of all available logistics resource elements to deliver customer requirements at the lowest cost
- Measure the total supply chain performance, based on effective delivery of products and services to customers
- Make maximum, effective use of competitive, global commercial capabilities
- Accomplish common requirements cooperatively.
- Provide a consistent structure, content, and presentation of logistics information, particularly when supporting common interfaces among the military services, Defense agencies, and international partners.
- Address logistics requirements and related costs early in the acquisition cycle and continue to the end of the life-cycle support period.
- Include all logistics requirements and costs in the program baseline and develop them initially without any internally or externally imposed financial constraints.
- Replace the practice of information ownership with a concept of information stewardship (e.g., shared data).
- Provide effective training and supporting technology to logistics personnel.

These twelve DoD adapted SCM principles will help guide the process of implementing SCM or development of strategic logistics management plans based on the fundamentals and principles of SCM.

The Guide further provides another concept to evaluate implementation of SCM which could prove useful to the aviation logistics manager in developing a strategic

logistics management plan; the Customer Service Pyramid, developed by William C. Copacino in *Supply Chain Management, The Basics and Beyond* (St. Lucie Press, 1997). The pyramid graphically "categorizes suppliers, internal processes, and improvement initiatives into logical groupings that identify the degree to which these elements contribute to the overall effectiveness of the supply chain-and ultimately to customer satisfaction." [Ref. 4:p. 19] These twelve SCM operating principles and the Customer Service Pyramid, "provide DoD logistics managers with two tools that aid in defining and assessing the relative value and potential contributions of process improvement initiatives, actions, and technologies as part of the supply chain implementation process." [Ref. 4:p. 19] The basic framework of the Customer Service Pyramid is a three tier hierarchy of reliability, flexibility, and creativity (innovation). By assessing the degree of change or transformation along these three tiers, aviation logistics managers can better develop a strategic logistics management plan founded on customer service. [Ref. 4:p. 19-20] The Customer Service Pyramid and definitions of each tier is depicted in Figure 2-2 below: [Ref. 4:p. 20]

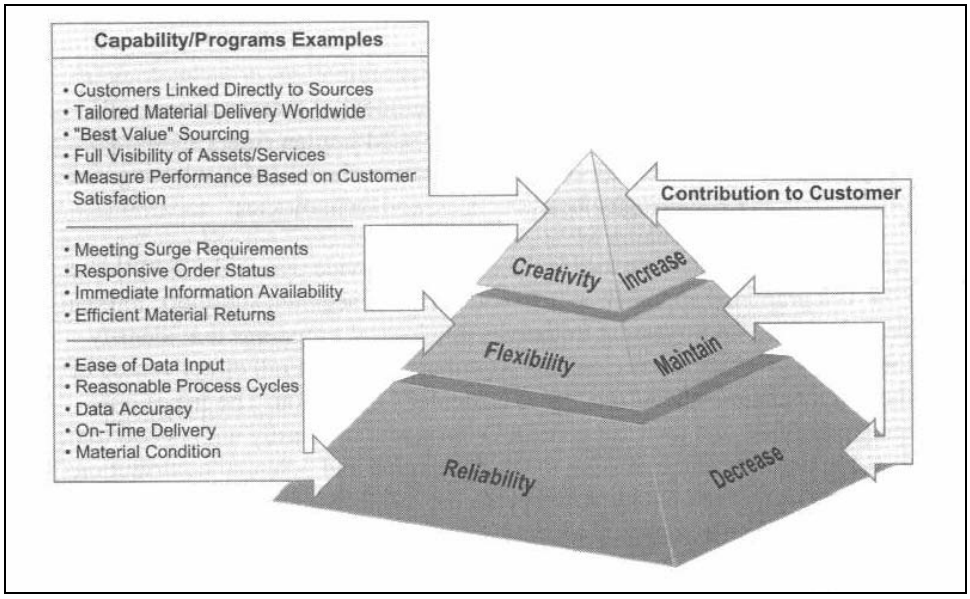

Figure 2- 2 Customer Service Pyramid (From Copacino, 1997)

D. SIX STEP PROCESS FOR IMPLEMENTING SUPPLY CHAIN MANAGEMENT

1. Step #1: Establish Your Implementation Team

Implementing SCM requires transitioning from traditional "stove-piped" or highly segmented functional organizations to a cross-functional "team" orientation. The Naval/Marine aviation logistics environment (e.g., natural resistance to change, command policies, doctrine, etc.) makes this an extremely difficult venture to accomplish. The SCM implementation team must identify key groups of high level officials or command leadership who are the principal decision makers, and obtain their support and commitment to implementing SCM. For our purposes, high level officials or command leadership might be the Marine Aircraft Wing (MAW) Commanding General, MAW Assistant Chief of Staff for Aviation Logistics, MAW Aviation Supply and Aircraft Maintenance Officers, Marine Aircraft Group Commanding Officer, MALS Commanding Officer, and aircraft squadron Commanding Officers. Marine aviation and logistics leaders must continually reinforce teamwork and achieving common goals. High level officials/command leaders also play an important role by informing and involving all major supply chain participants, including outside suppliers (e.g., Fleet and Industrial Supply Centers, the Naval Inventory Control Point, the Defense Logistics Agency, Naval Aviation Depots, etc.) and customers (aircraft squadrons). "Integration across functional processes is at the very heart of the SCM concept." [Ref. 4:p. 22] The SCM implementation team should be composed of members representing organizations within the command that are inherently involved in the three sub-functions of supply chain management: supply, maintenance, and transportation. [Ref. 4:p. 23]

With this in mind, at a minimum, the MALS SCM core implementation team should be comprised of the MALS Aviation Supply Officer (ASO), Aircraft Maintenance Officer (AMO), and the Logistics/Embark Officer (S-4). The MALS Commanding Officer (CO) should set the pace and vision (e.g., the Commander's Intent) for implementing SCM or the strategic logistics management plan. Depending on the operating environment within the Marine Aircraft Group, the CO might even serve as the

MALS SCM core implementation team leader to ensure success. Command leadership must give full and visible support to SCM implementation by linking measures and rewards to overall supply chain goals, rather than focusing narrowly on individual performance. [Ref. 4:p. 24] The primary challenge the MALS SCM core implementation team will realize is to accomplish process integration and teamwork despite the organizational barriers. [Ref. 4:p. 27] Table 2-1 provides the recommended participants for establishing a SCM implementation team at the Marine Aviation Logistics Squadron level. This table was adapted from a similar table in *The Guide* representing the SCM implementation team's core members. [Ref. 4:p. 26]

Organization	Purpose
MALS Headquarters	Provide policy guidance and interface with senior command and aviation logistics officials
MALS Aviation Supply Department staff	Provide core team leadership and staff support for the SCM initiative; provide material management, procurement, and distribution process expertise
MALS Aircraft Maintenance Department staff	Provide staff support for SCM initiative and maintenance expertise
MALS S-4 (Logistics Department) staff	Provide staff support for SCM initiative and transportation expertise
Operational commands' Organizational Maintenance Activity staff	Provide staff support for the SCM initiative and aviation logistics expertise for organizational level supply and maintenance processes; provide customer perspective
Marine Aircraft Group Fiscal Department and MALS Supply Accounting Division	Provide staff support for SCM initiative and financial management/budget expertise
MALS Automated Information Systems Department	Provide staff support for SCM initiative and aviation logistics information technology and communications expertise
Aviation logistics contract support (as required)	Provide SCM process and aviation logistics technical support expertise

Table 2-1 MALS Supply Chain Management Core Implementation Team (After Logistics Management Institute, 2000)

Developing the implementation strategy must first begin with drafting a Team Concept Document containing basic information about the Supply Chain Management effort. The Team Concept Document also serves the following purposes: [Ref. 4:p. 49]

- It provides the layperson with a basic, understandable SCM implementation project description
- It is a vehicle to reinforce management's support of the SCM initiative
- It helps explain the process to stakeholders, customers, and outside activities
- It helps institutionalize the project
- It is the first key step to creating other documents such as the strategic logistics management plan and a supporting plan of action and milestones

Based on recommendations from the *DoD Supply Chain Management Implementation Guide,* an adapted MALS SCM core implementation team concept document might include the following basic information: [Ref. 4:p. 49]

- A statement from the Marine Aircraft Group Commanding Officer expressing support for the MALS's SCM implementation project or strategic logistics management plan and its importance to the operational success and improved aviation logistics support within the Marine Aircraft Group. The MALS CO should also provide a statement articulating his vision or commander's intent for implementing SCM and the strategic logistics management plan.
- A copy of the twelve DoD SCM guiding principles or similar material
- A brief description of the SCM concept in terms of Marine aviation logistics
- A high-level graphical depiction of the Navy/Marine Aviation Logistics operational supply chain map peculiar to the organization (see Appendix A).

- A brief narrative of the MALS SCM core implementation team's mission and objectives (e.g., following the CO's vision and intent).
- A list of organizations and resources involved in the project are integral to the success of the recommended strategic logistics management plan.
- A brief description of potential SCM performance and cost benefits to the organization, with quantitative examples (if available). This could entail the Marine Aircraft Group or individual squadron aircraft readiness improvements, logistics response time reductions, improved customer service, minimizing flying hour program costs, minimizing direct maintenance man-hours per flight hour and cost, improving aviation logistics manpower training and certifications, etc.

After forming the team, there are several steps that focus on developing the team's skills. Training team members on supply chain management should be conducted by any means available. Chapter 4 of the *DoD SCM Implementation Guide* provides excellent ideas and resources for conducting training on the tenets of supply chain management. [Ref. 4:p. 50-53]

The next step the team should focus on is identification of *initial target areas of opportunity*. Although implementing supply chain management should be an end-to-end Navy/Marine Corps aviation logistics enterprise undertaking, the focus of this research is solely on implementing the principles of supply chain management at the tactical-level of Marine Corps aviation logistics only. Therefore, we assume that these initial target areas of opportunity are relative to the Marine Aviation Logistics Squadron only, and not to upstream members of the supply chain (wholesale supply activities, inventory control points, maintenance depots, etc.). The MALS SCM core implementation team develops the initial target areas of opportunity to create momentum and "buy-in" to implementing supply chain management before continuing with more advanced efforts associated with the strategic six step implementation process. The Logistics Management Institute

conducted a survey of high-level logistics managers from the military services to obtain key focus areas to SCM management success, which when coupled with the twelve guiding SCM principles, form a list of initial focus areas (see Table 2-2) for the MALS core implementation team to analyze: [Ref. 4:p. 54-55]

Focus Area	Purpose
MALS SCM Training	Identification of applicable SCM training resources relative to aviation logistics support and MALS operations in support of optimizing aircraft readiness within the air group
Squadron relationships	Development of concept for establishing integrated relationships with supported squadrons, including squadron expectations of aviation logistics support
Supply chain information sharing	Development of concepts for providing management and operational information to all supply chain participants and customers
Supply chain functional/organizational integration	Development of concept for process integration/communications across functional and organizational boundaries (e.g. inventory management, budget management, depot maintenance, deployment planning, etc.)
Supplier relationships	Development of concept for supply chain integration with and management of full range of materials/service suppliers (e.g., FISC, NAVICP, DLA, Depots, etc.)
MALS and supply chain performance metrics	Identification of initial group of MALS and supply chain-oriented performance and cost metrics for application throughout the N/MC aviation logistics supply chain

Table 2- 2 MALS SCM Core Implementation Team Initial Focus Areas

(after Ref. 4: p. 55)

The next step for the MALS SCM core implementation team is to develop Process Flow Diagrams (PFDs) graphically depicting the manual and automated operations performed by individuals and activities within the MALS aviation logistics supply chain through flowcharts. The PFDs should concentrate on the total processes (e.g., supply management, maintenance management, transportation and delivery management, etc.) rather than the specific functionality of each node within the supply chain (e.g., requisition process flow diagrams). [Ref. 4:p. 57] Marine Aviation Logistics

Squadron 14 accomplished this through the use of current and future reality trees, to be discussed in chapter 4.

Coupled with the tools highlighted above is the Plan of Action and Milestones (POA&M). Utilization of a POA&M will provide not only the MALS SCM implementation team with a coordination tool, it will also provide high level officials with the necessary information and updates on the progress of implementing the SCM or a strategic logistics management plan. POA&Ms are used widely in Marine aviation logistics, and should be an easily adapted tool for implementing SCM or a strategic logistics management plan.

2. Step #2: Develop Your Own Supply Chain Implementation Strategy (Strategic Logistics Management Plan)

This step describes the development of the actual strategic SCM implementation document, or for the purposes of the MALS utilizing SCM principles to improve aviation logistics support, a strategic logistics management plan. The *DoD SCM Implementation Guide* prescribes using a format similar to that described in the 1993 Government Performance and Results Act for developing a strategic plan which we have adapted for MALS use: [Ref. 4:p. 27]

- A comprehensive mission statement communicating the vision, focus, and expected commitment of all participants
- General aviation logistics goals and objectives, including outcome-related goals and objectives, for major functions to be covered by SCM or aviation logistics improvement initiatives.
- A description of how aviation logistics goals and objectives are to be achieved, including a general description of operational processes, skills, and technology, as well as human, capital, information, and other resources required to meet those goals and objectives.

- Descriptions of how process (or functional areas of processes) performance goals included in this plan are related to the general goals and objectives of SCM or the MALS's strategic logistics management plan.

- Identification of key aviation logistics support activities and factors external to the MALS and beyond the MALS's control that could significantly affect achievement of general goals and objectives.

- A description of the evaluation methods to be used in managing and evaluating progress of the strategic logistics management plan.

- A plan of action and milestones (may be developed over time).

After the MALS SCM core implementation team develops the strategic logistics management plan, it not only must be approved by the appropriate level commander (e.g., MAG and MALS Commanders), but also "sold" to the major process stakeholders and customers (MALS aircraft maintenance and aviation supply personnel, Marine Aircraft Group squadron commanders, and organizational maintenance activities, etc.). [Ref. 4:p. 28] *The Guide* provides sequential strategies for successfully implementing a strategic logistics management plan which we'll discuss and adapt to Marine aviation logistics operations in the following paragraphs.

a. SCM Implementation Strategy #1: Determine Desired Performance Metrics

The MALS SCM core implementation team should assess the performance of the Marine aviation logistics supply chain beginning at the tactical level, and adopt objective performance measurement information. This segment of the implementation strategy naturally flows and leads to SCM implementation step 3: measuring performance. Examples include: [Ref. 4:p. 67-8] Issue rates (material readiness or supply effectiveness- tailored as required)

- Costs (Flying Hour Program, Non-Flying Hour Program, Direct Maintenance Man-Hours/Flight Hour or Dollar, etc.)
- Quality (inventory configuration, material condition, I-level repairs, work requests, Packaging-Handling-Storage-Transportation [PHS&T], etc)
- Customer service
- On-time delivery
- Cycle times (Turn Around Times, Mean Time To Repair)
- Asset utilization (aircraft, test benches, IMRL/SE, inventory, etc.)
- Responsiveness (deployment supportability, logistics response time and total customer wait time)
- Accurate identification of products and services offered (squadron material control expeditor training, supply and maintenance database integrity, tech pub library management, etc.)

The MALS SCM core implementation team should develop high level performance metrics and supporting or diagnostic metrics. According to *The Guide,* diagnostic metrics are "measures that relate to specific segments of the supply chain that must be quantified, managed, and improved to ensure achievement of overall performance and cost goals." [Ref. 4:p. 68] Diagnostic metrics should: [Ref. 4:p. 68-9]

- Be customer focused and assess how well customer needs are being met
- Link functional performance measures and goals to overall (MAG/MALS) mission and operational objectives and goals;

promote mutual execution of functional responsibilities and discourage functional conflict

- Establish process measures that monitor the use of (MAG/MALS) resources
- Establish baselines to provide a context of historical performance for evaluating improvement initiatives
- Establish comparison benchmarks to provide clear performance targets and feedback; facilitate progressive improvement
- Establish measures to prevent the cost of information collection and analysis from exceeding the benefits derived
- Assist managers in managing current operations and facilitating future planning by providing tools that evaluate program performance, cost, and management; provide a basis for changing the program; support planning, programming and budgeting

b. SCM Implementation Strategy #2: Assess Required Process Changes

In order to evaluate the performance measures derived through strategy #1, the MALS SCM core implementation team should proceed to designing the future supply chain process. Deriving the "to be" or future supply chain process requires evaluating the following three principle factors from *The Guide*: [Ref. 4:p. 73]

- Existing organizations, policies, procedures, and infrastructure assets
- Desired future performance objectives

- Required process changes identified by the (MALS) SCM core implementation team

The first principle, and likely the most difficult, requires the team focusing on the "current" logistics environment and culture. Organizational change is difficult, and SCM can be viewed as a threat to the status quo that senior and experienced Marine aviation logisticians have strived so long and hard to become "experts" at. Obtaining support from senior leadership and from the "rank and file" of aviation logisticians participating as members of the entire MALS supply chain team will be critical to breaking the barriers of organizational change. [Ref. 4:p. 73]

The second and third principles entail the MALS SCM core implementation team documenting the "to be" or future supply chain performance objectives and developing actions that accelerate process changes in that direction. According to *The Guide,* focusing on the second and third principles by "advocating change and being persistent" helps overcome natural barriers experienced in the first principle. [Ref. 4:p. 73] Challenging the current Naval and Marine Corps aviation logistics culture and environment will be extremely difficult to implement SCM on a global enterprise scale. Established and long accepted aviation logistics policies, procedures and processes are a large hurdle to implementing major reform and change. Coupled with this fact are the many separate activities within the Naval and Marine Corps aviation logistics supply chain primarily concerned with their own fragmented functional performance within the aviation logistics architecture, and not truly integrated with the exception of "arm's length" relations with the next immediate partner in the supply chain. The design of the future "to be" supply chain should be one that includes sharing of common data or **real time** exchange of information to optimize **integrated enterprise-wide** performance measures ultimately tied to sustaining aircraft readiness or operational availability (A_o). [Ref. 4:p. 74]

c. SCM Implementation Strategy #3: Assess/Develop Supplier Relationships

Addressing supplier relationships primarily deals with the external supply chain functions, and not the internal supply chain function of the MALS and supported customers. "Upstream" members of the external aviation logistics supply chain for the MALS include the supply point of entry (POE) which is the host supporting Marine Corps Air Station or Naval Air Station Supply Department. The next level of supply is the Navy Fleet and Industrial Supply Centers (FISC) responsible for the region in which the MALS is geographically located. West Coast and Reserve Marine Corps Air Stations and Naval Air Stations also serve as FISC partnership sites under FISC San Diego, California. This effort to consolidate air station inventories under the FISC umbrella created a virtual consolidation of Navy and Marine Corps wholesale aviation supply inventories. Beyond the FISC are the inventory control points (ICP) for repairable and consumable materials. The Naval Inventory Control Point Philadelphia (NAVICP-P) and the Defense Logistics Agency (DLA) provide wholesale-level repairable and consumables inventory management for the Navy and Marine Corps. Naval Aviation Depots (NADEPs) and defense contractors provide the aviation depot level repairable and depot level repairable remanufacturing capability for re-supplying Naval and Marine Corps wholesale and retail level inventories and overhauling major weapon systems (aircraft) and components.

Appendix A provides a detailed graphical depiction of the external aviation logistics supply chain. Future integration of logistics information management systems with the Naval and Marine Corps Air Station Supply Departments, FISCs, NAVICP-P and DLA is the key to furthering partnerships with upstream suppliers into a "truly integrated" SCM concept within the Navy/Marine aviation logistics infrastructure. Complete integration of these logistics management information systems will further enable the ICPs and NADEPs to ally themselves with industry to better forecast the demand and logistics requirements of the operational squadrons and optimize aircraft readiness.

The following key informational factors in improving alliances with upstream members of the Navy and Marine aviation logistics supply chain must be based on Responsiveness, Cost, Cycle time, and Quality: [Ref. 4:p. 79 and 84]

- Historical, actual, and forecast customer demands
- Supplier production and delivery capabilities
- Pricing information
- Technical data
- Forecast accuracy and support issues
- Government and commercial inventories
- Repair capacity and schedules
- Planned future orders
- Production/delivery lead times
- Transportation capacity and channels
- Tracking of orders and material deliveries

d. SCM Implementation Strategy #4: Determine Customer Expectations

The MALS SCM core implementation team must satisfy three questions in order to provide a "customer-focused supply chain." They are 1) who are the supply chain members, 2) what are their requirements, and 3) how will overall customer satisfaction be measured in the future supply chain? [Ref. 4:p. 86]

In answering the first question, there are two customers in the Marine aviation logistics supply chain at the tactical level: the organizational maintenance activity and the intermediate maintenance activity. These two activities provide the

means to achieving aircraft operational availability (A_o) and sustaining aircraft readiness. To answer the second question, the MALS SCM core implementation team must 1) take into consideration the customer's materials and services requirements more commonly referred to as the "seven R's" or "the **Right** product delivered to the **Right** place, in the **Right** condition and packaging, in the **Right** quantity, at the **Right** cost, to the **Right** customer, at the **Right** time," and 2) satisfy the customer's logistics information needs which have, over time, increasingly become more advanced than just "order and receive." [Ref. 4:p. 88 and 91] Better information provides the end customer with the better capability to ***plan*** and ***execute*** actions to provide resources and capabilities to maintain aircraft and optimize readiness.

e. SCM Implementation Strategy #5: Define/Redefine the Future or "To Be" Supply Chain

Using Process Flow Diagrams (PFDs), the MALS SCM core implementation team should construct a high level graphical depiction of the current "as is" supply chain, and then develop the future "to be" supply chain. Step four in the six step process discusses developing the high level operational graphic of the supply chain. Appendix A provides a detailed high level operational graphic of the Naval/Marine Corps aviation logistics supply chain. The future supply chain might not be that much different from the current supply chain from an activity point of view, but processes could change based on integration and cross-functionality across the various nodes of the supply chain. In our research, we propose the MALS SCM core implementation team utilize the same guidance proposed in *The Guide* in designing the future supply chain by evaluating those functions and processes within their span of control (basically at the MALS level and below). *The Guide* provides the following general approach in designing the future supply chain: [Ref. 4:p. 95]

- At a relatively high level, document functional activities to be included in the supply chain design. These activities generally are referred to as process elements.

- Using the documentation of basic process elements of the supply chain, create the high level operational concept graphic.
- Complete the identification and descriptions of supply chain performance and cost metrics. Using the process element documentation, cross-reference these metrics to specific elements or element groupings.
- Document a baseline of actual data to quantify the selected supply chain metrics.
- Perform 'gap' analysis to document differences between the performance of the current process and desired performance goals.
- Using the documentation of basic supply chain process elements, identify potentially applicable business practice improvements.
- Prepare the overall initial operational node connectivity diagram to document the end-to-end future supply chain process. Include narrative descriptions.
- On a continuing basis, revise the operational node connectivity diagram to reflect further refinement of process relationships and application of additional business process improvements.

Further supply chain design details will be provided in SCM Implementation Step #4.

f. SCM Implementation Strategy #6: Identify and Prioritize Initial Targets of Opportunity

As a part of designing the future supply chain, the MALS SCM core implementation team should identify areas of opportunity for improvement such as

"improved customer satisfaction, more effective sourcing, shortened cycle times, reduced inventories, or operational savings." [Ref. 4:p. 96] Identifying and exploiting early areas of improvement will provide the MALS SCM core implementation team the justification and means to further long range SCM implementation and/or strategic logistics objectives.

g. SCM Implementation Strategy #7: Leverage Ongoing Business Process Reengineering and Systems Modernization Initiatives

The MALS SCM core implementation team should identify and coordinate with other Navy/Marine Corps aviation logistics activities, Navy/Marine Corps logistics activities, DoD or other service logistics activities, and/or commercial activities involved with business process improvements and systems modernization efforts. The MALS SCM core implementation team should be especially involved in business process or systems modernization efforts directly or indirectly affecting Marine aviation logistics or their command in particular. Although many of these activities might be high-level strategic logistics organizations primarily involved in initiatives on a very broad logistics scope, MALS SCM core implementation team involvement can ensure Marine aviation logistics issues and concerns are properly addressed. Two examples of current business process improvement and systems modernization efforts directly affecting Marine aviation logistics that the MALS SCM core implementation team can participate in are the Naval Aviation Readiness Integrated Improvement Program (NAVRIIP) and the Naval Supply Systems Command and the Naval Air Systems Command's joint venture; the Supply Maintenance Aviation Reengineering Team (SMART) Enterprise Resource Planning (ERP) pilot project.

NAVRIIP is an Chief of Naval Operations directed initiative to "implement a comprehensive program to make fundamental process changes in the way enabling resources are provided to CONUS non-deployed aviation commands in support of training and readiness objectives." [Ref. 6] The objectives of NAVRIIP are to:

> define, attain and sustain near and long term non-deployed aviation readiness goals. NAVRIIP will operationalize the Aviation Maintenance and Supply Readiness (AMSR) group initiatives by balancing and aligning interactions

> among O-level maintenance; I level maintenance and the logistics infrastructure that supports them (including D-level maintenance). A secondary objective of NAVRIIP is to identify opportunities for leveraging non-deployed naval aviation readiness process improvements in other US Navy programs including surface and subsurface. NAVRIIP will feature the systematic identification and removal of process barriers using ***entitled cycle time*** as basic driver of process change. The NAVRIT will focus on and accelerate, wherever possible, near and long-term CONUS non-deployed planeside readiness improvement initiatives, ensuring all initiatives are fully integrated with N43's in-service support objectives. NAVRIIP will use a ***total Cycle Time methodology*** that measures entitled cycle time dynamically for a ***predictive metric*** that systematically identifies, measures and prioritizes the key drivers of critical readiness support process [Ref. 6]

Although NAVRIIP is primarily, if not solely, concerned with improving the non-deployed readiness of Navy squadrons and aircraft in the Inter-Deployment Training Cycle (IDTC), the MALS SCM core implementation team, Marine aviation logisticians, and Marine aviation logistics planners should partner with their Navy counter-parts to leverage aviation logistics improvements, and further SCM-oriented initiatives as an integrated Navy/Marine aviation logistics team.

The second example, the SMART project, is the major initiative that support's the Naval Supply System Command's (NAVSUP) strategic objective of "developing and deploying an enterprise business solution for core business functions." [Ref. 8] As defined on the NAVSUP Enterprise Resource Planning (ERP) webpage,

> Enterprise Resource Planning (ERP) is the integration of business processes that optimize functions across an enterprise. The "enterprise" in this case refers to Navy Supply and Naval Aviation Maintenance and means taking advantage of commercial best business practices toward the goal of improving supply and maintenance support to fleet customers. [Ref. 8]

The overall goal of the Navy's SMART project is to,

> demonstrate that an ERP system can replace the Navy's legacy wholesale (UICP) and stock point (U2) supply systems. As a test of the ability of an ERP system to handle Navy supply and maintenance operations, the SMART pilot has a limited scope and addresses supply and maintenance as it pertains to the E-2C Hawkeye aircraft and the maritime LM-2500 gas turbine engine. The focus is on maintenance planning and supply chain material management processes. The Pilot will go-live at the Regional Supply Office (RSO) Norfolk, the Aviation Intermediate Maintenance Department (AIMD) Norfolk, the Naval Inventory Control Point (NAVICP) and the Naval Aviation Depot

(NADEP) North Island. In addition, there will be users at DFAS Norfolk and FISC Norfolk. [Ref. 8]

The SMART project is just one of several initiatives the Navy and other defense agencies are working on that the MALS SCM core implementation team can leverage in order to achieve the long term objective of SCM implementation, integrate with upstream members of the aviation logistics supply chain, and/or improve strategic logistics management.

h. SCM Implementation Strategy #8: Select /Implement Process Change, Enabling Software and Technologies

This last strategy element is the last in developing the MALS SCM strategic logistics management plan. After completing the first seven strategic objectives, the MALS SCM core implementation team must identify process change and technology applications that can achieve the desired results. [Ref. 4:p. 102] As identified in strategic objective #7, Enterprise Resource Planning (ERP) is the only current commercial off the shelf software system that includes nearly all the aspects of supply chain management in one program. Our recommendation is the MALS SCM core implementation team leverage current initiatives with ERP in order to advance SCM implementation in Marine aviation logistics and improve strategic logistics management.

3. Step #3: Measure Performance

The Guide recommends DoD activities utilize performance measures or metrics developed through research by Robert S. Kaplan and David P. Norton using a "balanced scorecard" approach [Ref. 9] and according to the Supply Chain Council's "Supply Chain Operations Reference" or SCOR model, which is based on industry best practices of SCM. [Ref. 4:p. 69] Metrics based on the balanced scorecard approach measure: [Ref. 4:p. 69-70]

- Meeting the strategic needs of the enterprise The enterprise in this case is tactical Marine aviation; the strategic need being aircraft readiness or operational availability (A_o).

- Meeting the needs of the individual customers Individual customers in this case are organizational and intermediate maintenance activities directly involved with maintaining aircraft within a Marine Aircraft Group or Aviation Combat Element of a Marine Air Ground Task Force.

- Addressing internal business performance Internal business performance applies to the performance of the MALS Aviation Supply, Aircraft Maintenance, and Logistics (S-4) departments.

- Addressing process improvement initiative results Measuring and analyzing results of process improvements via process metrics tied to optimizing aircraft readiness.

The adapted SCOR model for defense use is structured around four Level-1 processes: Plan, Source, Maintain, and Deliver. Table 2-3 provides definitions of each process of the adapted SCOR model. [Ref. 10:p. 3-4]

Function	Definition
Plan	Processes that balance aggregate demand and supply for developing the best course of action that meets established business rules
Source	Processes that procure goods and services for meeting planned or actual demand
Maintain (originally "Make")	Processes that transform goods to a finished state for meeting planned or actual demand. In the defense environment, this applies to repairing or overhauling spare parts or components or outright procurement of finished goods from industry
Deliver	Processes that provide finished goods and services, including order management, transportation management, and warehouse management, for meeting planned or actual demand

Table 2- 3 Definitions of SCOR Level 1 Processes (from Ref. 4:p 3-4)

The SCOR model was designed in order to provide organizations the means to: [Ref. 10:p. 3-4 to 3-5]

- Communicate with suppliers using common terminology and standard descriptions;
- Use the model as a planning and forecasting tool;
- Leverage metrics and benchmarking to determine performance goals, set priorities, and quantify the benefits of process changes;
- Link functional and process metrics to enterprise performance in a structured way;
- Understand practices that yield the best performance;
- Understand the SCM process and evaluate overall performance; and
- Identify the best software tools for their process requirements.

The Logistics Management Institute (LMI) developed performance measures for DoD activities based on the balanced scorecard concept and the SCOR model gauging the following: customer service, cost, and readiness and sustainability measures. [Ref. 4:p. 70]

a. Customer Service Measures

- *Perfect Order Fulfillment* Defined as the ratio of perfectly satisfied orders to total orders measured from the customer's perspective. A perfect order meets the following criteria:
  - Delivered complete; all items delivered in the quantities requested

- Delivered on time, using the customer's definition of on-time delivery
- Complete and accurate documentation (including packing slips, bills of lading, and invoices) to support the order
- Delivered in perfect condition and in the perfect configuration to be used by the customer, faultlessly installed (as applicable).
- The customer's Required Delivery Date (RDD) or the Uniform Material Movement and Issue Priority System (UMMIPS) time standards will be used. [Ref. 11:p. 3-46 to 3-58]

- *Supply Chain Response Time* Defined as the total length of the supply chain measured in days. LMI further adapted the SCOR model for DoD activities to only include average "source" and "order" cycle times because "plan" time is included in administrative lead time, and "maintain" time is included in "source" cycle time because repair activities are a major source of supply for aviation depot level repairables and depot level repairables. [Ref. 10:p. 4-4] Customer Wait Time (CWT) is a current DoD metric that measures the time from input of the customer's requirement to delivery of the required material throughout the entire end-to-end supply chain enterprise. [Ref. 4: p. 70-1]
  - Source Cycle Time Defined as the cumulative lead time (Administrative Lead Time [ALT], supplier lead time, receiving time, and handling time) from demand identification until the material is available. For

repairables, source cycle time is the average dollar weighted time to obtain new items from new procurement (ALT and production lead time [PLT]) and repair (retrograde time and repair cycle time [RCT]). For consumables, it is merely ALT and PLT. Source cycle time at the MALS should reflect the time it takes to receive material (stock and direct-turnover [DTO] requirements) from "off-station" or external to the MALS. This would entail aggregating the time spent a requisition flows through the entire Naval/Marine Corps aviation logistics supply chain, graphically depicted and described in Appendix A. Source cycle time should be filtered by: [Ref. 10:p. 4-4]

- ✓ In order: Squadron, MALS, Supply point of entry (POE) and/or Fleet and Industrial Supply Center, Inventory Control Point, Defense Distribution Depot (DDD), Supply POE, and MALS. A separate category covering time accrued with the contractor (direct vendor delivery, contractor logistics support, or third party logistics) should also be included.
- ✓ Repairable and consumable items
- ✓ Weapon system or type-model-series aircraft (type equipment code)
- ✓ Commodity or cognizance code
- ✓ Essentiality (project code)

- Order Fulfillment Time or Deliver Lead Time Measured from the customer's perspective, is defined as the average lead time from customer signature and authorization to order-receipt, order-receipt to order-entry-complete, order-entry-complete to order-ready-for-shipment, and order-ready-for-shipment to customer-receipt-of-order. This process is analogous to the "on-station" or internal requisitioning process described in Appendix C between supported Marine Aircraft Group squadrons and the MALS. The aggregated time is commonly referred to as logistics response time or LRT. These values can also be analyzed from either a single line item requisition point of view, or from a job perspective (e.g., a component awaiting parts [AWP] in the Intermediate Maintenance Activity) where a weapons replaceable assembly (WRA) accrues time in AWP and subsequently in maintenance where it undergoes repair once all parts are received (to effect repair). [Ref. 10:p. 4-5 to 4-6] LRT for a MALS should reflect only those customer requirements satisfied "on-station" from the MALS's inventory or Intermediate Maintenance Activity.

b. Cost Measures

- *Percent Change in Customer Price Compared to Inflation* Defined as the customer's price (standard price for consumables, standard and net price in the case of repairables) compared with inflation. The LMI study and *The Guide* both define this further by representing the customer's price as a market basket of secondary items similar to a market basket of

goods in the Cost Price Index (CPI). [Ref. 10:p. 4-6] For the MALS, we recommend evaluating the annual, semi-annual, quarterly, and monthly price change notices of individual line items and aggregate inventory (by end item or weapon system application) in the Naval Aviation Logistics Command Management Information System (NALCOMIS) against historical prices to analyze variances in spending. Knowledge of inflation rates and ICP-imposed surcharges are also important in understanding and accurately evaluating price variances and their impact on the Navy/Marine Corps Flying Hour Program budget performance.

- *Supply Chain Management Costs as a Percent of Sales at Standard Price* Sales revenues amount to the cost of issue transactions to customers. Supply chain costs include: [Ref. 10:p. 4-7]

    - Management Information System (MIS) Costs These are costs incurred maintaining and operating supply chain-related logistics management information systems and supporting automated data processing systems. In the MALS, this could apply to Shipboard Uniform Automated Data Processing System-Real Time (SUADPS-RT), Intermediate Maintenance Activity (IMA) NALCOMIS Phase II, Optimized IMA (O-IMA) NALCOMIS, Relational Supply (R-Supply), Streamlined Alternative Logistics Transmission System (SALTS), and International Maritime Satellite usage (INMARSAT).

    - Supply Chain Planning Costs These are costs associated with forecasting, developing finished goods or end-item

inventory plans, and coordinating the demand and supply process throughout the supply chain, including all channels.

- Inventory Carrying Costs These are costs associated with gross inventory adjustments due to losses and surveys, obsolescence and shelf life expiration for consumable and repairable inventories.

- Material Acquisition Costs These are the costs of material management and planning, supplier quality engineering, inbound freight and duties, receiving and storage, inspection, material process engineering, and tooling.

- Order Management Costs These are the costs of creating customer orders; order entry and maintenance costs; contract, program, and channel management costs; installation planning costs; order fulfillment or delivery costs; distribution costs; outbound transportation costs; and customer invoicing and accounting costs.

- *Inventory Turns* Defined as the total issue costs by the value of the inventory at current fiscal year standard prices, excluding war reserves (pre-positioned stocks, Fly-In Support Packages and Supplemental Aviation Spares Support pack-up kits). Repairable transactions do not provide an accurate measure at the MALS level because issues "off the shelf" do not record an immediate standard price financial transaction (or charge). Costs recorded with a repairable inventory turn (issue) are strictly repair parts costs associated repairing the squadron's

retrograde, or if the squadron's retrograde is beyond the capability of IMA maintenance (BCM), the cost recorded is at the net (carcass turn-in value) price. In the event of destroyed, missing, lost, stolen, or unrecoverable repairable retrograde (carcass), the standard price will be charged to the squadron for the material issue. When repairable retrograde is not processed by the MALS appropriately though the Navy's Advanced Traceability and Control (ATAC) network, the squadron could potentially be charged standard price for the repairable inventory turn (issue). This measure is not reflective of the entire Marine aviation logistics supply chain. [Ref. 10:p. 4-7 to 4-8]

c. Readiness and Sustainability Measures

- *Upside production flexibility* Defined by the SCOR model as the number of days to achieve an unplanned, sustainable 20 percent increase in production. The LMI defines this measure as "the number of days required to achieve a sustainable posture for executing the national military strategy of fighting two Major Theater Wars (MTWs)." [Ref. 10:p. 4-8] This metric is difficult to adapt to the MALS, especially in light of the changing defense environment and national military strategy. A similar measure might gauge the number of days required to surge to wartime demand rates. The LMI uses the example, "if it takes 60 days to increase production to the two MTW demand rate, then 60 days of war reserve stock are needed to ensure and uninterrupted supply." [Ref. 10:p. 4-8] *The Guide* further adds that this measure includes "the repair days needed to support most-demanding current operational scenarios." [Ref. 4:p. 71]

The LMI developed three additional performance measures not addressed by the SCOR model. These three measures are a cost perspective to support a weapon system, an additional metric to support a two MTW (or as the national military strategy directs), and peacetime operating performance metrics that measure wartime readiness and sustainability. LMI defines each in more detail:

d. Cost Perspective: Weapons System Logistics Costs as a Percent of Acquisition Price

This metric is defined as the cost of ownership of the weapons system as a percent of the acquisition price adjusted for inflation, modification and upgrades. NAVAIR's definition of total ownership cost is "Total Ownership Cost includes all costs associated with the research, development, procurement, operation, logistical support and disposal of an individual weapon system including the total supporting infrastructure that plans, manages and executes that weapon system program over its full life." [Ref. 12] Some elements of total ownership cost include total secondary item costs, total depot and IMA end-item repair costs (material and labor), and total organizational-level maintenance labor. Currently, the MALS is graded on a fractional total cost (operations and maintenance support costs) of ownership as a function of operating hours flown. This "operating cost per flight hour" is gauged against a historical benchmark (OP-20 target cost per flight hour) by individual type-model-series aircraft. Measuring the total cost of ownership against the acquisition price is not a useful measurement at the MALS level.

e. Readiness and sustainability perspective; Operational Availability (A_o) or weapon system non-mission capable (NMC) rates

Full Mission Capability rates are equipment readiness metrics the Navy and Marine Corps uses to measure aircraft operational availability (A_o). The Non-Mission Capability (NMC) rate is the inverse of the Full Mission Capability (FMC) rate, and represents a weapon system not capable of performing its assigned mission (aircraft downtime). Aggregate NMC rates are composed of two elements: aircraft downed for

maintenance and aircraft downed for parts or supplies. [Ref. 10: p. 4-9] This performance measure should be used in concert with other measures that can be filtered or assigned to a specific weapon system, or type-model-series aircraft assigned to a Marine Aircraft Group or an Aviation Combat Element the Marine Aviation Logistics Squadron is assigned to support.

f. Readiness and sustainability perspective; war reserve ratio

This metric is defined as the ratio of (ready for issue or condition code "A") war reserve assets on-hand to war reserve requirements. [Ref. 10:p. 4-10] The ratio should be filtered by:

- Weapon system
- Marine Aviation Logistics Squadron (custodian)
- Repairable or consumable material
- Marine Aviation Logistics Support Program category
- Commodity if Field-level Repairable (FLR) or consumable

These enterprise level performance measures can be easily applied to measure aviation logistics operations at the tactical level within the MALS. Current aviation logistics policies, procedures, and processes should be evaluated and adapted, if necessary, to satisfy the intent of these measures for measuring supply chain performance at the MALS level, but also at the enterprise level throughout all of Naval and Marine Corps aviation. Appendix D of *The Guide* provides more detailed performance measurements based on SCOR model. [Ref. 4:p. 226-240] The MALS SCM core implementation team may find good use of these detailed performance measures in not only evaluating process and functional performance of the MALS, but also for proactively detecting trends and primary degraders detracting the MALS from achieving the ultimate goal of contributing to the Marine Aircraft Group's and individual squadron's aircraft operational availability (A_o).

4. Step #4: Designing Your Supply Chain

In the "Strategy Implementation" step, we discussed the strategy of designing the supply chain. Designing the supply chain involves describing and graphically depicting the flow of material throughout the entire end-to-end logistics process. In the case of designing the supply chain for Marine aviation logistics, we intend to develop the overarching Navy/Marine Corps aviation logistics end-to-end supply chain, and then focus on one specific segment of that chain, the Marine Aviation Logistics Squadron (MALS). By utilizing the same principles in designing the overarching graphic, the MALS SCM core implementation team can design the supply chain internal to the MALS and the end customer, the aircraft squadrons. After constructing a high level operational graphic of the Naval/Marine Corps aviation logistics supply chain, the process flow diagrams (PFDs) can be mapped and performance metrics assigned to the overall aviation logistics process internal to the MALS and supported squadrons. By utilizing the process flow diagrams, the performance metrics can also be mapped down to individual functions with the process flow, to detect trends and identify primary degraders preventing achievement of performance goals. This section provides examples of supply chain designs for MALS SCM core implementation teams to use based on adapted SCOR methods, and recommendations from *The Guide.*

Figure 2-3 shows the high level graphical depiction of the end-to-end Navy/Marine Corps aviation logistics supply chain based on an adapted SCOR model by the Supply Chain Council.

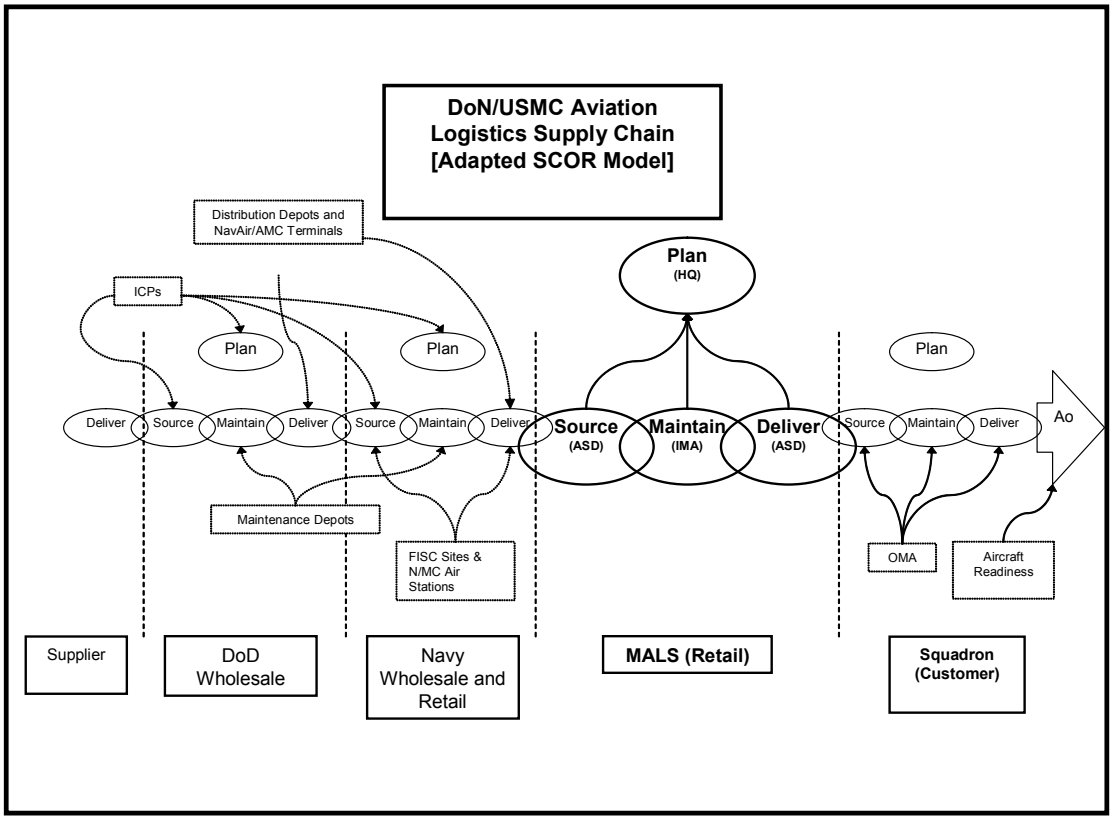

Figure 2- 3 Navy/Marine Corps aviation logistics supply chain high level graphic (after Ref.104:p. B-1)

The aviation logistics flow starts with the customer, the aircraft squadron. Marine aircraft squadron organizational maintenance activities are the lowest element of the supply chain providing and sustaining aircraft Operational Availability (A_o) or Fully Mission Capable (FMC) aircraft. The next supply chain segment is the Marine Aviation Logistics Squadron (MALS). The MALS is the primary supporting retail supply point and intermediate maintenance activity. The next segment in the supply chain is the Navy wholesale and retail supply points composed of the Naval Inventory Control Point-Philadelphia (wholesale level), Fleet and Industrial Supply Centers and their sites (wholesale level), Marine Corps Air Station and Naval Air Station Supply Departments

(wholesale and retail level), and the Naval Aviation Depots and depot-level commercial contract maintenance activities. Following the Navy wholesale and retail supply points are the Department of Defense wholesale supply and distribution points composed of Defense Logistics Agency inventory control points, Defense Distribution Center Depots. The last segment of the supply chain is commercial suppliers: direct vendor delivery suppliers, 3rd party logistics providers, and other potential commercial suppliers. Appendix A provides an alternate and more detailed high level operational graphic of the current Naval/Marine Corps aviation logistics supply chain. The graphic in Appendix A displays the network aspects and extreme complexity of the supply chain, as well as maps displaying physical locations of the members of the supply chain.

The focus of this thesis is the evaluating the performance of the MALS segment of the Naval/Marine aviation logistics supply chain. The next step for the MALS SCM core implementation team is to develop the process flow diagrams. Figure 2-4 is an example of a process flow diagram mapping the entire Navy/Marine Corps aviation logistics supply chain utilizing an adapted SCOR model. [Ref. 10:p. B-1]

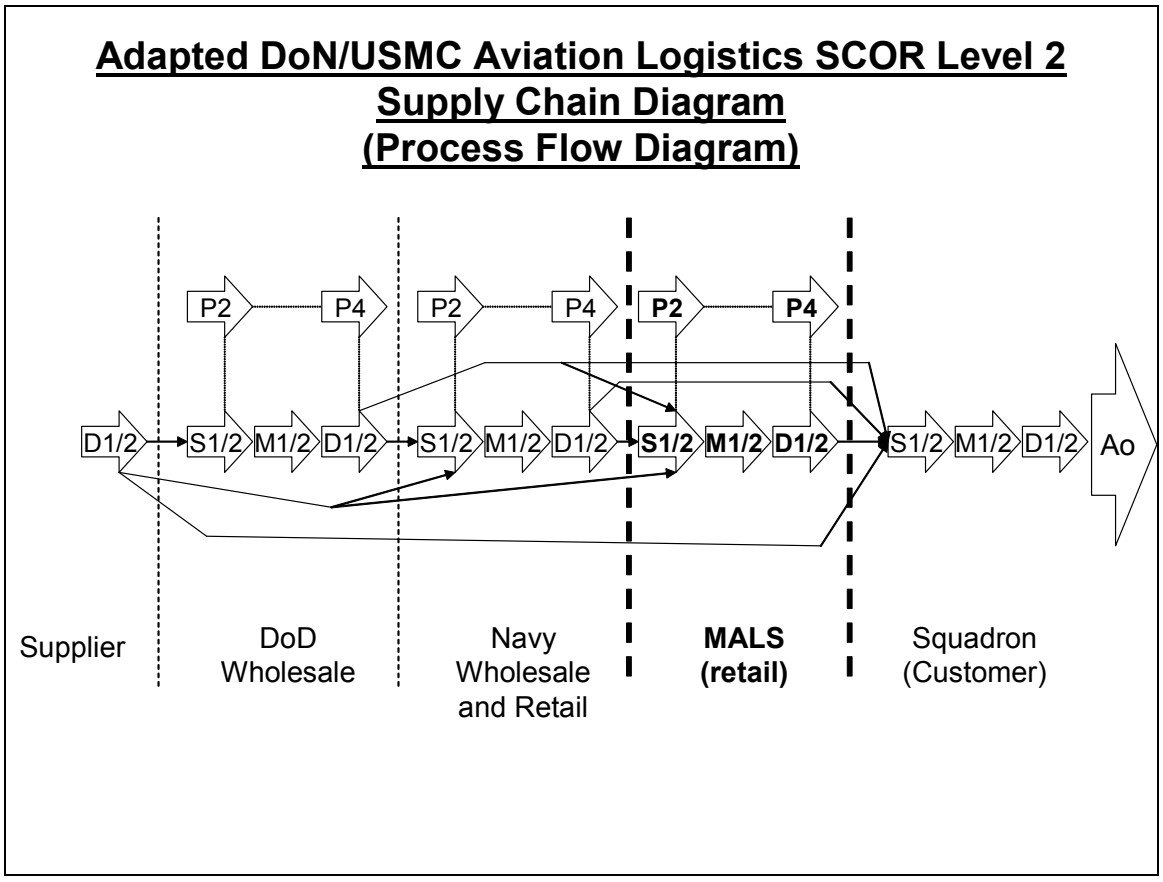

Figure 2-4 Naval/Marine Corps Aviation Logistics Supply Chain Process Flow Diagram (after Ref.10:p. B-1)

The MALS SCM core implementation team could utilize the process flow diagram shown in Figure 2-4, with the corresponding process definitions based on an adapted SCOR model, depicted in Figure 2-5 below: [Ref. 10:p. A-2]

Adapted SCOR Level 2 Process Definitions

- **P2 (Plan Source)** = The development and establishment of courses of action that represent a projected appropriation of material resources to meet supply chain requirements.
- **P4 (Plan Deliver)** = The development and establishment of courses of action that represent a projected appropriation of delivery resources to meet delivery requirements.
- **S1 (Source Stocked Material)** = The procurement, delivery, receipt, and transfer of raw material, subassemblies, and make-to-stock products in a finished goods state (Ready For Issue or Condition Code "A")
- **S2 (Source Make-to-order Material)** = The procurement and delivery of material built to a design or configured based on the requirements of a customer order (i.e. Expeditious Repair or EXREP)
- **M1 (Make to Stock)** = The process of manufacturing products (make-to-stock products are intended to be shipped from finished goods (Ready For Issue or Condition Code "A") or "off the shelf," completed before receipt of a customer order, and produced generally in accordance with a sales forecast). This same concept applies to "re-manufactured" products, which in the Marine aviation logistics environment would be classified as Aviation Depot Level Repairables (AVDLRs), Depot Level Repairables (DLRs), and Field Level Repairables (FLRs).
- **M2 (Make to Order)** = The process of manufacturing products (make-to-order products are intended to be completed after receipt of a customer order and are built or configured only in response to a customer's order, i.e. EXREP). This same concept applies to "re-manufactured" products, which in the Marine aviation logistics environment would be classified as Aviation Depot Level Repairables (AVDLRs), Depot Level Repairables (DLRs), and Field Level Repairables (FLRs).
- **D1 (Deliver Stocked Product)** = The process of delivering a product maintained in a finished goods state (Ready For Issue or Condition Code "A") before the receipt of a firm customer order.
- **D2 (Deliver Make to Order Products)** = The process of delivering a product manufactured (re-manufactured), assembled, or configured from standard parts or subassemblies; manufacture (re-manufacture), assembly, or configuration begins only after the receipt and validation of a firm customer order.

Figure 2-5 Adapted SCOR Model Level 2 Process Flow Diagram Definitions (after Ref. 10:p. A-2)

The MALS SCM core implementation team should proceed beyond the adapted SCOR "level 2" processes, and develop even more detailed sub-process diagrams (adapted SCOR "level 3") depicting actual flow of material within the MALS to the supported squadrons. Mapping the "level 3" sub-processes (plan, source, maintain and deliver within the MALS) will allow the team to identify where to apply performance measures to integrate functional areas and improve logistics responsiveness and achieve

increased aircraft readiness. Figure 2-6 is a proposed example of a level 3 subprocess for the "Deliver" level 2 process within the MALS. Actual process flow diagrams can be substantially more detailed, providing more specific descriptions of functions within a process (e.g., MALS-14 use of Theory of Constraints and logic trees for mapping parts management within the MALS).

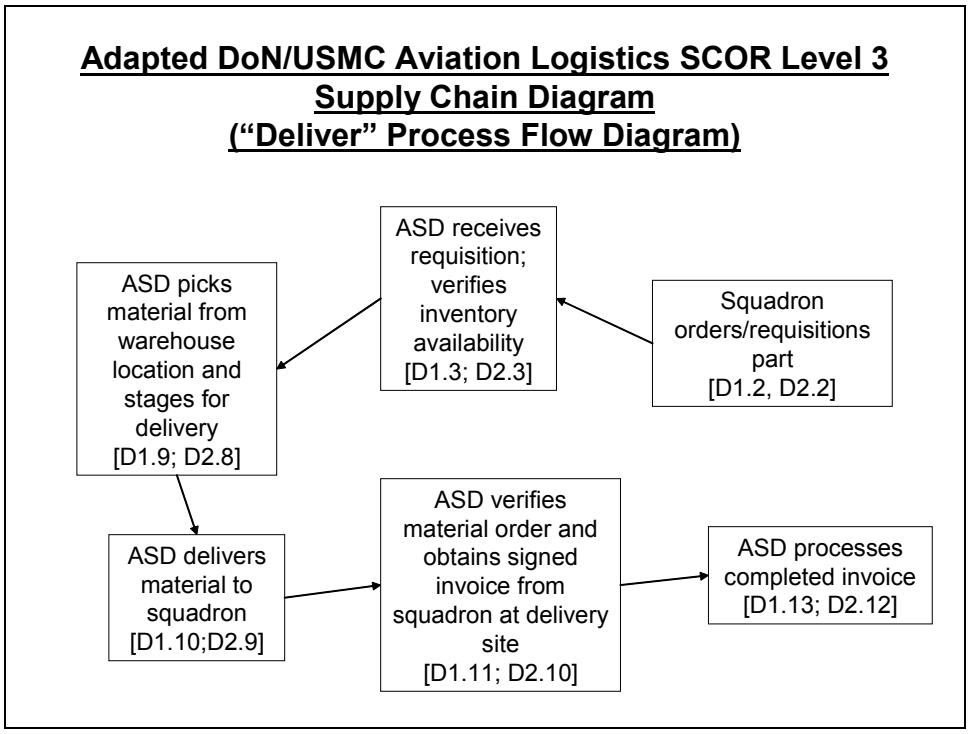
Adapted DoN/USMC Aviation Logistics SCOR Level 3
Supply Chain Diagram
("Deliver" Process Flow Diagram)
ASD receives requisition; verifies inventory availability [D1.3; D2.3]
ASD picks material from warehouse location and stages for delivery [D1.9; D2.8]
Squadron orders/requisitions part [D1.2, D2.2]
ASD delivers material to squadron [D1.10;D2.9]
ASD verifies material order and obtains signed invoice from squadron at delivery site [D1.11; D2.10]
ASD processes completed invoice [D1.13; D2.12]

Figure 2-6 Adapted SCOR "Deliver-Stocked Product/Make-To-Order Product" Level 3 Process Flow Diagram (after Ref.104:p. A-3)

Appendix B provides SCOR level 3 process definitions for the "deliver-stocked product/make-to-order product" process at the MALS level. Appendix C provides an alterative to the adapted SCOR model process flow diagram. This alternate example provides a more detailed process flow diagram depicting the flow of material from a Marine a squadron through the MALS (requisitioning, issuing, and repair cycle process).

After designing the supply chain, and mapping the supply chain processes and subordinate functions to the desired depth to apply enterprise and diagnostic performance metrics, the MALS SCM core implementation team can begin analyzing where supply

chain deficiencies occur, and apply best business practices and target performance to achieve improvements. [Ref. 4:p. 122-23] Robert Handfield and Ernest Nichols developed a list of common supply chain process deficiencies illustrated in Table 2-4: [Ref. 13:p. 54-56]

•**Waiting**---inordinate wait time in multi-step processes •**Serial vs. parallel operations**---Activities that could be accomplished simultaneously •**Batching**---Unnecessary combining of activities, causing delay •**Lack of synchronization in materials movement**---Inefficient movement or poor timing of required movement •**Poorly designed procedures and forms**---Inefficient design or use of tools that delays or disrupts supply chain •**Lack of information**---Information not available or non-existent •**Limited coordination**---Failure to obtain required input or action from employees or managers •**Limited cooperation**---Lack of commitment or understanding from supply chain participants; poor motivation or lack of common objectives	•**Non-value-added activities**---Activities that should be eliminated •**Repeating process activities**---Nonrequired duplication of activities •**Excessive controls**---Unneeded approvals or reviews •**Ambiguous goals and objectives**---Organizational objectives not understandable and clear to employees, suppliers, or customers •**Poor communication**---Ineffective flow of information between personnel or systems •**Outdated technology**---Failure to modernize equipment •**Lack of/ineffective training**---Training not available or not properly focused on correct subject matter

Table 2- 4 Common Supply Chain Process Deficiencies (from Ref. 4:p. 123)

5. Step #5: Selecting and Applying Best Practices and Technologies

After designing the supply chain, identifying and mapping supply chain processes and functions relevant to the organization, and applying supply chain performance metrics to processes and functions, the next logical step is to evaluate the use of best business practices and technology to assist in implementing SCM throughout the organization. Best business practices and technology can also be used as enabling tools for executing and achieving the objectives and goals of a strategic logistics management

plan. Although *The Guide* provides interesting recommendations on best practices and technologies for implementing SCM, they are outside the scope of this thesis. Contrary to what is recommended in *The Guide*, we feel that many best practices and enabling technologies for implementing SCM are outside the scope of this thesis because implementing "true" supply chain management should be accomplished throughout all of Navy/Marine Corps aviation logistics, and not solely within the MALS. On the other hand, we feel the SCM principles and implementation strategy recommended in *The Guide* not only could improve aircraft readiness and aviation logistics processes and functions, but also prepare the MALS for eventual SCM implementation throughout Navy/Marine Corps aviation logistics enterprise. Our interpretation and adaptation of *The Guide's* "implementing best practices and technology" is actually aggressively seeking out and implementing proposals identified during Step #2 "Developing the Supply Chain Implementation Strategy;" specifically those best practices and technologies identified in SCM Implementation Strategies #7 (leverage ongoing business process reengineering and systems modernization initiatives) and #8 (select/implement process change, enabling software and technologies).

In this context, we feel the best practices and technologies identified in *The Guide*, can be applied to Marine aviation logistics in a limited fashion. The best practices identified in *The Guide* include the near industry standard on SCM, the Supply Chain Operations Reference (SCOR) model, which was described in depth earlier in this chapter. Our emphasis in utilizing an adapted version of the SCOR model is for the MALS to utilize it as a potential roadmap for utilizing supply chain management principles and integrating with customers and upstream supply members to improve logistics responsiveness and aircraft readiness at the tactical level of Marine aviation logistics. The maximum benefit of utilizing the SCOR model can only be achieved through complete integration of SCM principles throughout all activities of the Naval/Marine Corps aviation logistics supply chain. A more relevant business process improvement initiative is naval aviation's NAVRIIP project explained earlier in this chapter.

Enabling technology for implementing SCM also must not be acquired solely for the MALS, or even for Marine aviation logistics, but rather on a strategic venture to support all of Navy/Marine Corps aviation to avoid creation or continuation of dysfunctional, stove-piped, and stand-alone logistics management information systems, decision support systems, expert systems, internet-based software applications, and other associated software. We recommend the MALS SCM core implementation team, and Marine aviation logisticians and planners throughout all levels of Marine aviation for that matter, become knowledgeable and proactively engage with current Department of the Navy Enterprise Resource Planning (ERP) pilot projects. Specifically, we recommend direct involvement by MALS SCM core implementation team and MALS "subject matter experts" in the NAVAIR/NAVSUP ERP pilot project ("SMART" initiative) also discussed earlier in this chapter. Participating with the SMART Integrated Product Team (IPT) members and pilot project personnel at Naval Air Station Oceana Aircraft Intermediate Maintenance Department and Supply Department will ensure that Marine aviation logistics-specific processes, functions or aviation logistics doctrine peculiar to Marine aviation logistics is considered, tested and implemented as a part of the SMART pilot project development prior to fielding to the operational forces. Failure to do so could result in extremely costly post-production software changes to conform to Marine aviation logistics requirements. These proactive efforts will prepare the MALS and supported aircraft squadrons for the eventual implementation of ERP as the Navy and Marine Corps' aviation logistics supply chain management information system of the future. *The Guide's* clear recommendation is that ERP is the only current software application technology designed to "consolidate the disparate functions of supply and logistics into a comprehensive supply chain planning suite." [Ref. 4:p. 165]

6. Step #6: Managing Supply Chain Implementation

The sixth and final step of SCM implementation is management. According to *The Guide*, most DoD logistics managers are entrenched in the "day-to-day problems of logistics operations, and feel they are unable to effect the changes needed to relieve near term problems." [Ref. 4:p. 174] Most DoD and Navy/Marine Corps aviation logistics managers focus on their own functional areas within the supply chain enterprise, or what

we refer to as their "spheres of influence" and "spans of control." For example, a Supply Response Division (SRD) Officer within a MALS is concerned with minimizing the average customer wait time for "off-station" material requirements, or direct turn-over requisitions external to the MALS. Essentially, the SRD Officer's "sphere of influence" resides with members of the supply chain external to the MALS (e.g., downstream members such as aircraft squadrons; and upstream members such as the DLA Inventory Control Points). The SRDO's "span of control" resides with managing squadron requirements before they are referred to upstream members of the supply chain. This includes performing technical research on requirements that have been determined to be "not-carried" or "not-in-stock" in inventory. The day-to-day operational concern for the SRDO is to eliminate direct turn-over requisitions, especially mission critical and readiness degrading requisitions. Oftentimes, the SRDO is not primarily concerned about integrating efforts with the Repairables and Consumables Management Division (RMD and CMD) Officers to optimize the range and depth of inventories in order to ***prevent*** off-station DTO requisitions from ever occurring (the best case scenario). Integrating efforts with the RMDO and CMDO will improve long term readiness and logistics response time more than any short term readiness and customer wait time (CWT) improvements achieved simply through aggressively expediting DTO requisitions. More aptly put, RMD and CMD should be putting SRD out of business! In today's cultural environment though, the typical SRD Officer considers RMD and CMD are separate functional areas within the MALS Aviation Supply Department, with "spheres of influence" and "spans of control" separate from his/her own.

Considering the opportunity for dysfunctional relations between the Supply Response, Repairables Management and Consumables Management Division officers, it is no wonder that *The Guide* states most cross-functional logistics issues and concerns are addressed at only the highest levels of the organization. [Ref. 4:p. 174] *The Guide* further states that effective management of the supply chain requires logistics managers to master not only knowledge and expertise in their responsible functional areas, but also "fully understand and work toward enterprise-wide objectives by tracking actual progress in attaining degrees of improvement in supply chain competencies." [Ref. 4:p. 176]

Integral to properly managing the supply chain is the Marine aviation logistics manager's access to performance metrics information on all aspects of the Marine aviation logistics supply chain. Most metrics provide information useful only for functional areas, and in best case scenarios, only a process within a segment of the total supply chain enterprise. Most metrics do not gauge the entire total supply chain performance and its contribution to achieving the goals and objectives of an organization, and are not "linked or correlated to one another so managers can consider important supply chain relationships" (e.g., supply material availability, supply effectiveness, and fill rate metrics of upstream supply chain members are high yet squadron readiness rates are declining). [Ref. 4:p. 182] Earlier in this chapter, we proposed SCM performance measures as a part of the SCM implementation strategy that capture total supply chain performance (adapted SCOR model performance measures). These same measures can be fractionalized and used to capture the supply chain performance of segments of the supply chain, or in our case, the MALS. Later in this thesis we will analyze how MALS-14 developed and implemented their strategic logistics management plan, and developed a "one page management" reporting tool that enabled all "stakeholders" and members of the MALS aviation logistics supply chain, from the most junior IMA work center maintainer to the MALS Commanding Officer, to manage processes and functions critical to improving and sustaining aircraft readiness and logistics responsiveness within the entire air group.

E. SUMMARY

In summary, we developed in this chapter a basic foundation of understanding the Naval/Marine Corps' aviation logistics infrastructure from a supply chain management perspective, based on the Logistics Management Institute's *DoD Supply Chain Management Implementation Guide*. A precipitate of this analysis was designing a high-level graphical model mapping the complex Naval/Marine Corps aviation logistics supply chain network and a detailed process flow diagram describing the tactical aviation logistics operations of the Marine Aviation Logistics Squadron (MALS). These two graphics will help provide Marine aviation logisticians a visual reference for developing **performance measures for the MALS** that can be integrated with upstream aviation

logistics activities, and are based on the principles of SCM. With this in mind, this chapter also provides the structural framework for developing the performance measures and outline for a strategic logistics management plan for improving Marine aviation logistics at the strategic and tactical level. The basic framework was the **Six Step Process of Implementing Supply Chain Management** as proposed in *The Guide*. With this foundation, we can now better analyze and understand in Chapter 4 how MALS-14 successfully implemented a strategic logistics management plan based on a "structured planning and feedback system" and the Theory of Constraints management philosophy that improved aircraft readiness within MAG-14.

Although *The Guide's* impetus was to provide a plan to implement SCM throughout the end-to-end logistics and supply enterprise of an organization, our focus is on the tactical-level segment of the Naval/Marine Corps aviation logistics supply chain: the Marine Aviation Logistics Squadron. Developing a specific strategic logistics plan for implementing supply chain management and performance metrics for the Naval/Marine Corps aviation logistics supply chain enterprise is outside the scope of this thesis. Most of the fundamentals discussed in **The Six Step Process for Implementing SCM** can be applied within the Marine Aircraft Group and Marine Aviation Logistics Squadron in order to develop SCM-oriented performance metrics that will 1) improve current and future aviation logistics support and aircraft readiness where required, 2) help prepare the for the eventual implementation of SCM within Naval/Marine aviation logistics, and 3) once SCM is implemented, serve as the overarching logistics strategy to integrate all Naval/Marine Corps aviation logistics supply chain activities' performance metrics towards a common goal: aircraft readiness or operational availability (A_o).

With these strategic performance measurement objectives in mind, we conclude *The Guide's* **The Six Step Process for Implementing SCM** is relevant to Naval/Marine Corps aviation logistics and the Marine Aviation Logistics Squadron. Chapter 5 will reveal the specific performance measures that are SCM oriented and are intimately tied to optimizing aircraft readiness or operational availability (A_o).

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III. STRATEGIC MANAGEMENT AND THE THEORY OF CONSTRAINTS

A. OVERVIEW

Prior to conducting the case study of MALS-14, it is imperative for the reader to have a basic understanding of the philosophy of the Theory of Constraints and how it can be applied to supply chain management. Therefore, the objectives for this chapter are to (1) establish an understanding of the Theory of Constraints, (2) substantiate the need for a global goal to focus the efforts of supply chain management, (3) illustrate how Logic Trees are used to identify system constraints, (4) show how the Five-Focusing Steps are used to eliminate or mitigate a constraint, and (5) illustrate how TOC can be used as a framework for strategic planning.

B. BACKGROUND

Theory of Constraints (TOC) evolved from the theories and teachings of Dr. Eliyahu M. Goldratt, a physicist who realized that scientific principles and the rules of logic could be applied to processes in order to provide on-going improvement for the system as a whole. A prescriptive theory, TOC aims not only to explain why (Logic Trees) but also offer guidance on what to do (Five Focusing Steps). Theory of Constraints is "a collection of system principles and tools, or methods for solving the problem of improving system performance." [Ref. 3:p. xxi] For example, Throughput Accounting and Drum-Buffer-Rope are examples of TOC centered techniques used by many businesses in accounting and production management. Theory of Constraints has one clear objective: to succeed in achieving more of an organization's goal by focusing on the area(s) that have a dramatic impact on the whole organization. This focus requires an understanding of (1) systems (supply chain), (2) the global goal of the organization (supply chain), and (3) constraint identification and management.

C. SUPPLY CHAIN MANAGEMENT

1. A Systems Approach

A system is a "collection of interrelated, interdependent components or processes that act in concert to turn inputs into some kind of outputs in pursuit of some goal. [Ref. 3:p. 3] As the system takes inputs, acts on them through some process, and produces outputs, the outputs have greater value than the sum of the inputs. Therefore, the system might be said to add value to the inputs as the system turns them into outputs.

A supply chain is a system. Definitively, a supply chain is the "continuous, unbroken, comprehensive, and all-inclusive logistics process, from initial customer order for material or services to the ultimate satisfaction of the customer requirement." [Ref. 3:p. 13] Therefore, supply chain management is the design, maintenance, and operation of supply-chain (logistics) processes for satisfaction of end-user needs.

Goldratt emphasizes a systems approach to achieving more of the system's goal. Specifically, TOC focuses on the interdependencies of the component processes that make up the system. "Goldratt contends that systems are analogous to chains, or networks of chains. Each link in the chain is a component process." [Ref. 3:p. xxi] The DoN/MC Aviation Logistics Supply Chain is a system designed to sustain and support aircraft weapons systems (see Appendix A). Thus, each link (DLA, MALS, etc.) within the supply chain is a component of the system that adds value to sustaining and supporting aircraft weapons systems.

As part of an integrated supply chain, each organization (DLA, NADEP, MALS, etc.) within the supply chain influences or is influenced by the interdependency of the supply chain as a whole. Therefore, any action taken by an individual organization must give consideration to the impact that action will have not only on its organization but also on the supply chain as a whole. This emphasizes the need for organizations to have an understanding of their supply chain (macro) and how their organization fits and functions within the supply chain (macro and micro). One of the first steps in developing a strategic plan for SCM is to develop a Process Flow Diagrams (PDFs) of the supply chain

end-to-end. Figure 3-1 is the system model of the supply chain for Aviation Depot Level Repairables. The arrows depict the interdependency of the system as products and information move throughout the supply chain.

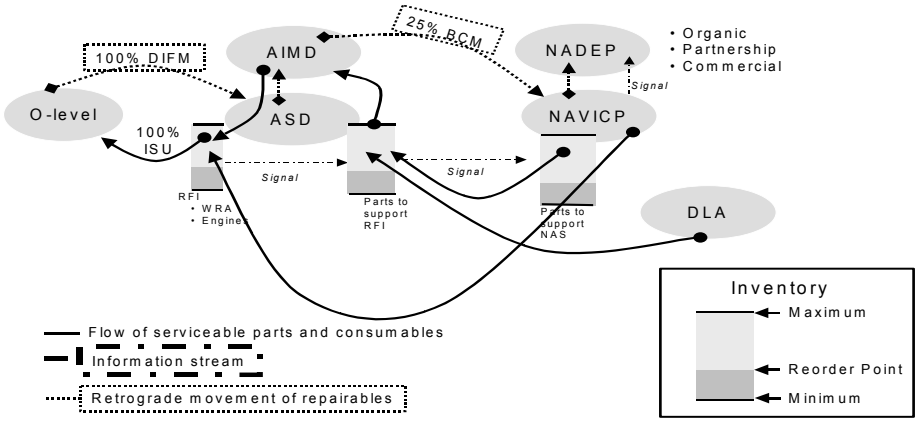


Figure 3-1: Replenishment System (AVDLR only)

If each organization within the supply chain is driven to optimization without regard to the system as a whole, the flow of products across the system will not be optimized**.** [Ref. 14:p. 160**]** Moreover, implementation of SCM in DoD cannot focus solely on individual functions within an organization but must rather concentrate on the end-to-end process. However, before SCM can be fully adopted, organizations must "integrate their internal logistics processes before attempting to link operations with external suppliers and distributors." [Ref. 14:p. 161] This is the impetus behind MALS-14's Strategic Planning Initiative.

Because systems are analogous to chains, the systems performance is limited by the weakest link in the chain. "If all the parts of the system are performing as well as they can, the system as a whole will not be – the system optimum is not the sum of the local optima." [Ref. 15:p. 12] Simply put, focusing on everything is focusing on nothing. This lack of focus can cause increases in inventory, cause increases in cycle time, and limit productivity of the system as a whole. More importantly, by focusing solely on efficiencies and by optimizing resources in every area, the DoN/MC Aviation Logistics

Supply Chain will fail to maximize overall effectiveness of the integrated supply chain and will not achieve more of its goal – sustaining and supporting aircraft weapons systems.

2. Global Goal of Supply Chain Management

Theory of Constraints requires the goal of the organization as a whole be clearly identified and brought into focus by everyone within the organization. This goal is the global goal of the organization for which all decisions and actions lead to achieving. Therefore, identifying the global goal is imperative when developing and implementing a strategic management plan.

At this point it is important to differentiate between a necessary condition and a goal. A necessary condition is "a condition or state that must be satisfied in order to realize a system's goal." A goal is "the purpose for which the system is created." [Ref. 15:p. 359] Due to the interdependent nature of necessary conditions and the system goal, failing to satisfy necessary conditions results in system failure. Furthermore, Dettmer emphasizes that the goal should be "stated in a way that implies continuum, not absolute destination." This continuum facilitates continuous improvement – the impetus of philosophy of Theory of Constraints.

The DoN/MC Aviation Logistics Supply Chain is a system of interdependent organizations working in concert to achieve a goal. The *2000 DoD Strategic Logistics* Plan states the DoD Logistics goal or mission is to "provide responsive and cost effective support to **ensure readiness and sustainability for the total force…**" This goal is consistent throughout the strategic plans, doctrine, and operational documents of the supply chain. Marine Corps Warfighting Publication (MCWP) 3-21.2 states "the O-level maintenance mission is to maintain assigned aircraft and aeronautical equipment in a full mission capable (FMC) status". Likewise, "the I-level mission is to enhance and sustain the combat readiness and mission capability of supported activities by providing quality and timely support". [Ref. 2:p. 1016] Therefore, the **global goal of the DoN/MC Aviation Logistics Supply Chain is readiness or operational availability (A_o)**.

3. Identifying Constraints

Because the supply chain is a system, and systems are analogous to chains, constraints are the weakest link in the chain. A constraint is a bottleneck or chokepoint, or anything that limits the system from achieving more of its goal. A constraint prevents us from satisfying the necessary conditions that lead to achieving the goal. Figure 3-2 is a simple production example of a system. The constraint within this system is the throughput of Step C – 8 units per day.

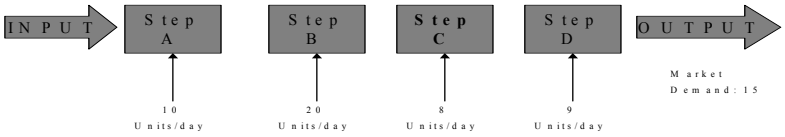


Figure 3-2 Process Flow of Production System

The throughput of the system can never be greater than 8 units per day unless steps are taken to eliminate the constraint and increase throughput. Therefore, any effort not focused on improving Step C will not improve overall production or meet market demand – the goal of the product line. Although Step C is the capacity constraint within the production system, another method must be used to identify the root cause of the constraint (ie. resource constraints).

The constraints within the DoN/MC Aviation Logistics Supply chain are primary readiness degraders. Primary readiness degraders are factors (funding, weapons system reliability, sparing levels, manpower, etc.) that have a direct impact on A_o. Like the production system example, another method of analyzing cause and effect relationships has to be applied to identify the root cause of the system constraint.

Theory of Constraints uses five distinct logic trees (Current Reality Tree, Future Reality Tree, Prerequisite Tree, Transition Tree, and Evaporating Cloud) and the "rules of logic" to map out cause and effect relationships. The application of each type of logic

tree is beyond the scope of this thesis. The purpose here is to provide an example of how logic trees can be applied to supply chain management and to show the cause and effect relationship of the logistics measures outlined by Benjamin Blanchard in *Logistics Engineering and Management (5th ED)*.

Figure 3-3 models of the logical cause and effect relationship between the logistics measures and the goal of aircraft readiness.

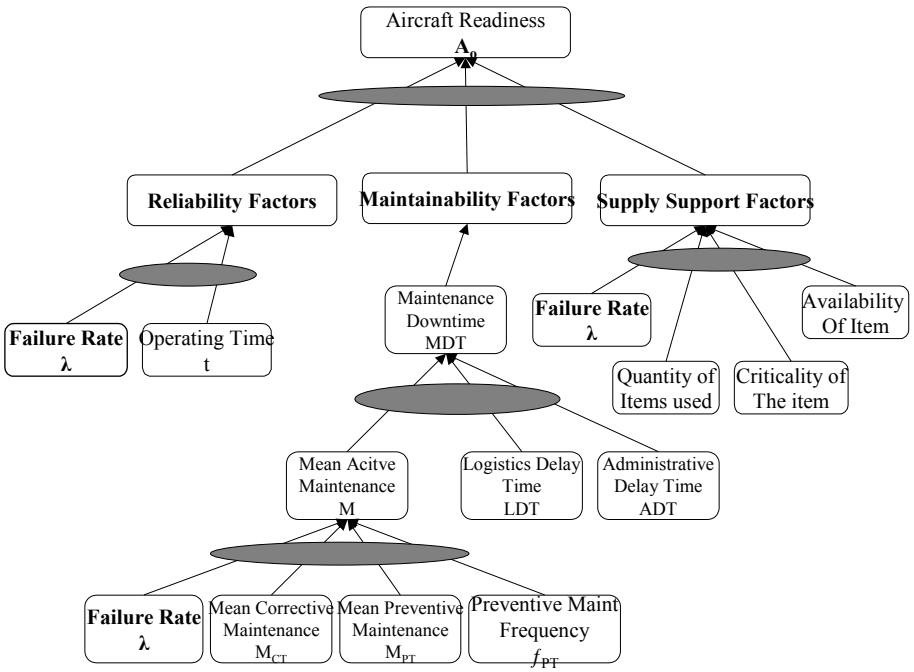
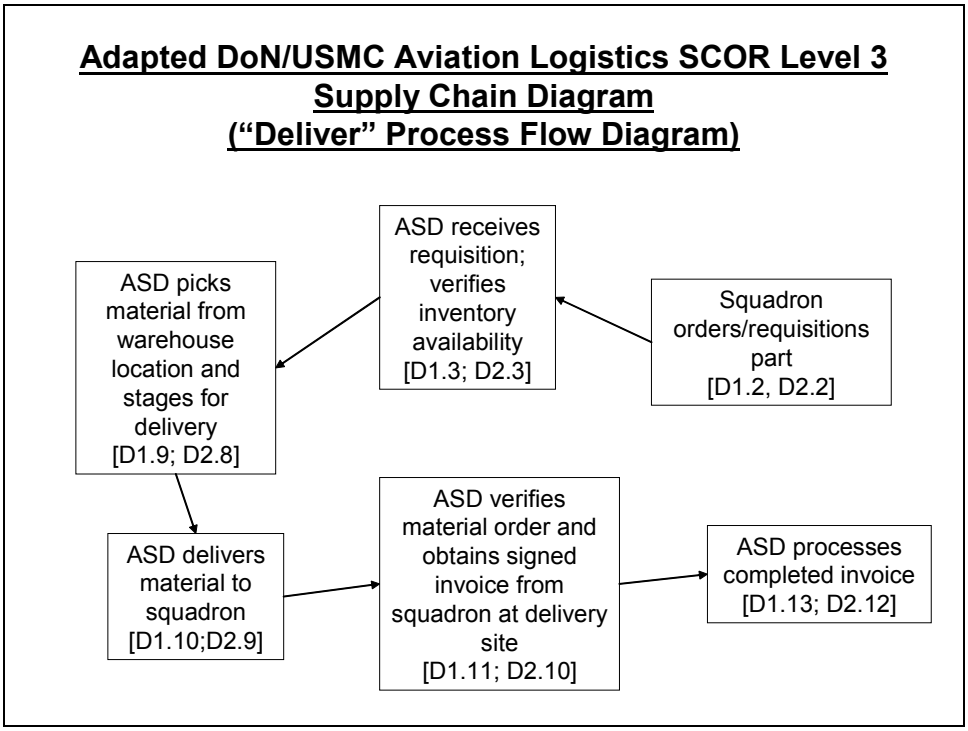


Figure 3-3 Cause and Effect Relationship of Logistics Measures and Operational Availability using Logic Tree

The importance of reliability is apparent in the model. The failure rate, λ, is a factor which impacts all three of the logistics measures. Therefore, a cause and effect relationship exists between reliability (failure rate) and the operational availability of a weapon system. The undesirable effect of poor reliability has a direct impact on the logistics support plan and life cycle cost of the weapon system. It is imperative for the Program Manager and the Integrated Product Team to understand this cause and effect relationship when making tradeoff decisions and the down-stream affect those decisions will have.

4. Managing Constraints

Once the constraint - anything keeping a system from achieving higher performance versus its goal - has been identified, the next step is to either break the constraint or manage to the constraint using the Five Focusing Steps. [Ref. 16:p. 5] Goldratt has written extensively on how to use the five focusing steps. In this section we will define the steps and apply them to the Level 3 SCOR model.


Adapted DoN/USMC Aviation Logistics SCOR Level 3
Supply Chain Diagram
("Deliver" Process Flow Diagram)
ASD receives requisition; verifies inventory availability [D1.3; D2.3]
ASD picks material from warehouse location and stages for delivery [D1.9; D2.8]
Squadron orders/requisitions part [D1.2, D2.2]
ASD delivers material to squadron [D1.10;D2.9]
ASD verifies material order and obtains signed invoice from squadron at delivery site [D1.11; D2.10]
ASD processes completed invoice [D1.13; D2.12]

a. *Step 1: Identify the Constraints*

Identifying the constraints is the single most important step to achieving greater performance and continuous improvement. Systems will typically have more than one constraint. This requires you to prioritize the constraints according to their impact on the goal.

For example, customer wait time is a key performance measure linked to operational availability. The Aviation Supply Officer has determined the Repairables/Consumables Delivery Branch is the constraint within the system. Figure 3-4 diagrams the requirements of the Delivery Branch.

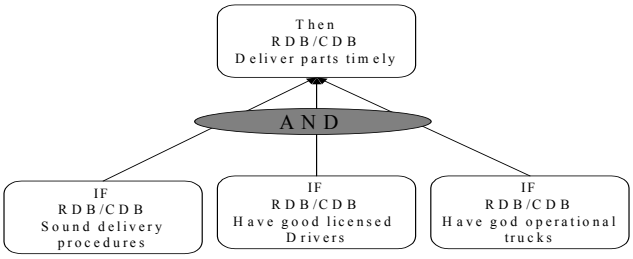


Figure 3-4 Logic Tree for Delivery Branch

Once the logical cause and effect relationship is developed, the factor or root cause of the constraint can be identified. In this case, having two delivery sections was the root cause.

b. *Step 2: Exploit the Constraint*

Once you have identified the constraint, you have to decide how to manage the constraint. If greater performance can be achieved by eliminating the constraint, do so. This means the step was a non-value adding step or waste – lean production. If the step is a value-adding step, you must get every bit of capability out of the constraint. In the Delivery Branch example, having two delivery sections was the root cause. Since delivering material to the squadron is a value-adding step, capability must be maximized to improve performance. Therefore, RDB and CDB were combined to create one Delivery Branch. The Branch was more efficient and more effective than two delivery sections – customer wait time decreased.

c. *Step 3: Subordinate to the Constraint*

Once you have identified the constraint and decided how to exploit the constraint, the rest of the system must adjust to the constraint - Step C in the production example and combining the two sections in the Delivery Branch example. In the delivery branch example, neither the Repairables Branch nor the Consumables Branch wanted to give up control of their respective delivery sections. By subordinating to the decision to combine the two sections into one branch, the constraint was eliminated.

In the production example, the throughput of Steps A, B, and D must not exceed the throughput of Step C (8 units/day). If A and B are not adjusted, work-in-process (WIP) inventory will accumulate at step C and Step D will eventually go idle from lack of work. The technique used by TOC is the Drum-Rope-Buffer. Thus, if the constraint cannot be eliminated all together, subordinating to the constraint makes the system more efficient and more effective.

d. *Step 4: Elevate the Constraint*

At times it may be impossible to eliminate the constraint or improve performance without changing the system. Elevating the constraint may require reorganization, capital investment for additional resources, et cetera. In the production example, investing resources in Step C to make it a parallel step would improve the throughput to 16units/day. However, the improvements made to Step C would cause Step D to be the constraint. Likewise in the Delivery Branch example, the need for more licensed drivers or more trucks would have required elevating the constraint. NOTE: ALWAYS LOOK IN HOUSE FOR A SOLUTION BEFORE ELEVATING A CONSTRAINT!

e. *Step 5: Return to Step 1, BEWARE OF INERTIA*

Theory of Constraints is a continuous improvement process. Once one constraint has been eliminated, another constraint will limit the system – Step D in the

production example. WARNING – BEWARE OF INERTIA. A solution to a constraint will deteriorate over time as the operational environment changes. Therefore, a process of continuous improvement is necessary to ensure we maintain the efficiency and effectiveness of the system. Therefore, we return to Step 1 and continue the process.

D. PERFORMANCE METRICS AND THEORY OF CONSTRAINTS

Successful implementation of any SCM strategic plan requires measuring performance. Goldratt asserts that performance measurements should be based on two criteria: (1) "measurements should induce the parts to do what is good for the system" and (2) "measurements should direct managers to the point that needs their attention." [Ref. 17:p. 82] Furthermore, the Theory of Constraints links performance metrics to the organization's global goal through cause and effect relationships developed using Logic Trees. Therefore, aviation logistics performance metrics link supply chain management to the global goal of AVLOG – operational availability.

Figure 3-5 demonstrates the development of performance metrics through the application of the Theory of Constraints and Logic Trees.

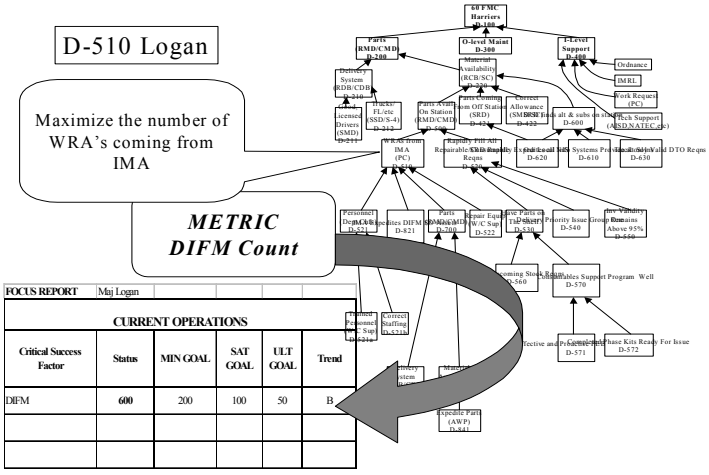


Figure 3-5 Developing Performance Metrics

Although the metric is related to a specific segment or functional area of the supply chain, the metric (DIFM) is linked to the total process of supply chain management by cause and effect – increasing or decreasing the DIFM has an effect on

the SUPO's ability to fill requisitions. Thus, DIFM count directly impacts customer wait time and ultimately operational availability. This substantiates the use of the Theory of Constraints as a framework for supply chain management.

E. SUMMARY

The DoN/MC Supply Chain is a system of interrelated, interdependent organizations and processes that are designed to sustain and support aircraft weapon systems. Therefore, the principles, tools, and methods of the Theory of Constraints can be used to improve system performance through the use of Logic Trees and the Five Focusing Steps. Process flow diagrams can be used to identify a bottleneck or constraint within the process; however, Logic Trees provide the means of identifying the root cause of the constraint through cause and effect relationships. Furthermore, we used the Five Focusing Steps to identify and eliminate the constraint within the SCOR Level 3 Delivery Process. In addition, we have shown how the Theory of Constraints and the Logic Trees link performance metrics to the global goal of the organization. In Chapter 4, we will show how MALS-14 applied these concepts to improve readiness in MAG-14.

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IV. MALS-14 STRATEGIC PLANNING PROCESS

A. OVERVIEW

"Strategic planning is a disciplined effort to shape and guide what an organization is, what it does, and why it does it." [Ref. 18:p. 4] The most important benefit of strategic planning is that it requires strategic thinking and action. Other benefits of strategic planning are (1) improved decision-making, (2) enhanced organizational performance, and (3) fulfillment of roles and responsibilities of the people throughout the organization. However, as Bryson points out, "strategic planning is not a panacea" and is "no substitute for leadership". Strategic planning is a set of concepts, procedures, and tools that help leaders focus on improving the performance of the organization to accomplish a mission, to meet mandates, and to satisfy stakeholders.

During 2001, Marine Aviation Logistics Squadron (MALS) 14 developed and implemented a structured planning and feedback system based on the Theory of Constraints to improve aircraft readiness within Marine Aircraft Group (MAG) 14. This case study will review the history of MALS-14 (what it is, what it does, and why it does it), review the approach to aircraft readiness prior to the implementation of MALS-14's plan, and review the phases of the MALS-14 Strategic Plan.

B. HISTORY OF MALS-14

1. What It Is, What It Does, Why It Does It?

Marine Aviation Logistics Squadron (MALS) 14 is the tactical aviation logistics squadron for Marine Aircraft Group (MAG) 14. The mission of MALS-14 is to provide intermediate-level maintenance, supply, and ordnance/armament support to sustain aircraft and aeronautical equipment availability to MAG-14. The MALS is the retail component of the DoN/MC Aviation Logistics Supply chain and the point of entry (POE) for all aviation logistics requirements for MAG-14.

In 1992, MAG-32 and MAG-14 merged into the largest MAG within the Marine Corps. Likewise, MALS-32 and MALS-14 merged and consolidated their core group of supervisory and support personnel and aircraft-specific maintenance personnel to form MALS-14 – the largest Marine Aviation Logistics Squadron in the Marine Corps.

Marine Aviation Logistics Squadron (MALS) 14 supports some of the oldest aircraft in the largest, most deployed, and most diverse MAG in the Marine Corps – 11 squadrons with 120 aircraft: TAV-8B, AV-8B (day, night, radar), EA-6B, and KC-130F&R Type/Model/Series. There are 1,170 Marines, Sailors, and Civilians assigned to MALS-14. The Supply Department manages approximately 26,000 items (repairables and consumables) valued at $336 million. The Maintenance Department has 44 production work centers and inducts approximately 3000 items per month providing full repair capability for 928 repairables and limited repair capability for 1,604 repairables.

2. Why MALS-14 Must Change?

Since the merger of the two Marine Aircraft Groups, readiness had never exceeded seventy percent for a consistent time. Contributing factors were lack of funding for spares and equipment, manning and training challenges, aging aircraft, and intense operational tempo. These factors, however, were not the overriding causes of poor aircraft readiness. **MALS-14 believed the most significant cause for poor readiness was wrong management focus**.

Typical approaches to aviation logistics management emphasized efficiencies and improvements that generated savings. This was due, in part, to the resource-limited environment in which we function. The aviation logistician's goal was to optimize resources across the entire supply chain. By focusing solely on efficiencies and by optimizing resources in every area, MALS-14 had failed to maximize the overall effectiveness of the organization. This is due to the inherent variability and dependency of the supply chain.

Current polices and practices aviation logisticians use to measure aircraft readiness do not accurately display how to effect positive change or prevent problems

before they happen. In fact, traditional metrics reinforce local efficiency behavior. In the Marine Corps and in the MALS, aiming to achieving efficiencies is what we have done well in the past, what we expect in the future (optimize resources in every area), and how we continue to measure how successful we are (reward savings and efficiencies). For example, IMA turnaround time (TAT), IMA beyond capability of maintenance (BCM) rate, and supply effectiveness are measures that have no apparent correlation to aircraft readiness. Figure 4-1 illustrates the lack of correlation between supply effectiveness (a MALS performance metric) and aircraft readiness for AV8Bs. Although supply effectiveness is relative steady, there are large variations in aircraft readiness with no correlated variation in supply effectiveness.

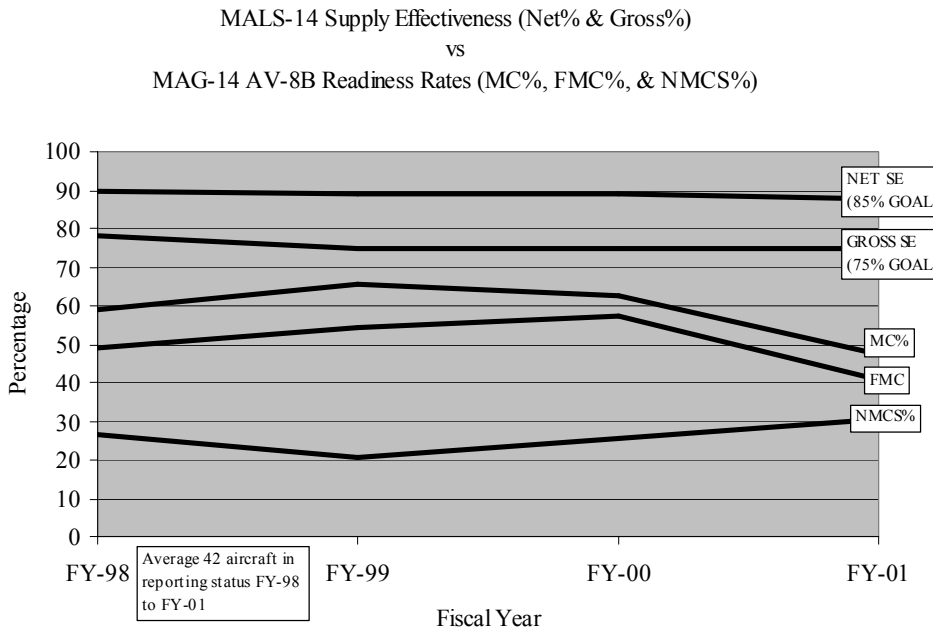


Figure 4-1: Supply Effectiveness vs. AV8B Readiness Rates

Yet, these internal efficiency metrics led MALS-14 to operate on the assumption that maximizing the performance of each component part of the system would automatically maximize the performance of the system as a whole – "Tell me how you are going to measure and I'll tell you how I'm going to perform". No matter how good

these metrics were, there was no correlated improvement in readiness. This led MALS-14 to some very pointed questions about what drives readiness.

Is the MALS measuring the right thing? Do such efficiency metrics directly correlate to the overall goal of aircraft readiness? Why, since 1992, if our efficiency metrics continue to meet the "standard", do our readiness numbers lag?

3. Current Approach To Readiness

To illustrate the typical management view, MALS-14 developed a supply chain model to apply to the MAG/MALS. Readiness begins and ends with organizational level maintenance, as illustrated in Figure 4-2.

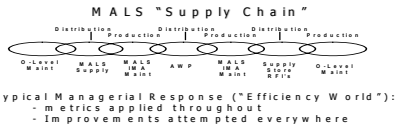


Figure 4-2: MAG –14 Supply Chain

Requirements originate on the flight line as the OMA determines on-aircraft material requirements. The MALS Supply Department provides a replacement part (if available) to the organizational level activity while simultaneously retrieving the retrograde part needing to be repaired. The NRFI part is inducted into the MALS IMA for repair in the appropriate work center. The part is added to the DIFM backlog and handled in priority order – typically first in, first out (FIFO). During the repair process some delays will occur (administrative, handling, awaiting test bench or technician, waiting in queue, etc.). The part may experience some considerable delays for repair parts and be held in "awaiting parts" (AWP) status. Once the component is repaired, it is returned to the supply warehouse for subsequent use at a later date to fill other on-aircraft requirements. Appendix C is the process flow diagrams for the OMA and IMA repair process and the repairable and consumable process flow for Supply.

The typical way MALS-14 managed the supply chain was to attempt to manage the entire system and seek improvements at every link in the chain. Supervisors were

rewarded for producing efficiencies within all the links in the chain. This was not the best approach; yet, this was what MALS-14 was doing when they measured local optimums and efficiencies. Today's measures (TAT, Supply Effectiveness, BCM rate, etc.) may have no correlation to overall readiness and the management approach that supports the use of such metrics may not be the best for achieving readiness.

To achieve a significantly higher level of readiness required a change in the way MALS-14 viewed readiness and the processes that drive readiness. The Theory of Constraints philosophy was the bold approach MALS-14 employed to drive change in MAG-14. The aim of MALS-14 to drive aircraft readiness was complex and burdened with challenges. TOC was an approach that enabled MALS-14 to achieve superior results in spite of some real-world challenges (e.g., under-funded programs, spares and manning shortages, training deficiencies, aging systems, etc.). TOC enabled the entire MAG and MALS to focus on what was the key to driving readiness (or constraining readiness) and TOC was ideally suited to create results in processes that were the core functions of the MALS (production and distribution).

C. MALS-14 STRATEGIC PLAN "ROADMAP" TO SUCCESS

The MALS-14 Strategic Plan consisted of seven phases:

- Phase I – Sharing the Vision
- Phase II – Values Training (Generating Commitment)
- Phase III – Training in TOC management
- Phase IV – Define MALS' goal(s) and supporting tasks
- Phase V – Identify Constraint
- Phase VI – Implement integrated reporting system (link to EIS)
- Phase VII – Manage by TOC methodology (employ 5 focusing steps)

1. Phase I - Sharing the Vision

a. *Implementation Team*

Phase I was the formation of the MALS-14 Implementation Team and the development of the MALS-14 Vision and Implementation Strategy. The implementation team was a cross-functional mix of Staff Non-commissioned Officers and Officers from

each of the departments (Headquarters, Maintenance, and Supply). The key members of the team were the Department Heads and Department Chiefs responsible for implementation of the strategy within their respective departments. By building a cross-functional team, ownership was built into the strategic planning process. More importantly, commitment and support of key leaders within the squadron helped reduce the resistance to change.

b. ***Vision Statement***

MALS-14 conceptualized and communicated their success through a Vision Statement (Appendix E) to provide overarching guidance and motivation and to detail MALS-14's vision for success, focus of effort (goal), and guiding principles. Figure 4-3 is the long-term vision MALS-14 developed. The vision statement emphasized an integrated, people-centric approach to success.

MALS-14 VISION

Every MALS-14 Dragon has a clear understanding of the MALS focus and each is a vital participant in a total team effort toward MALS-14 being recognized as the best large logistics activity in the Department of Defense.

MAG-14 enjoys high quality support from MALS-14. MALS-14 works very closely with the squadrons of MAG-14 as an integrated logistics team.

Dragons possess a deep sense of professional DRAGON PRIDE and esprit as members of the MALS-14 team.

Figure 4-3: Vision of MALS-14 Success

The vision statement linked the goal of MALS-14 (aircraft readiness) to the success of MALS-14 – "Nulli Secundus" (Figure 4-4).

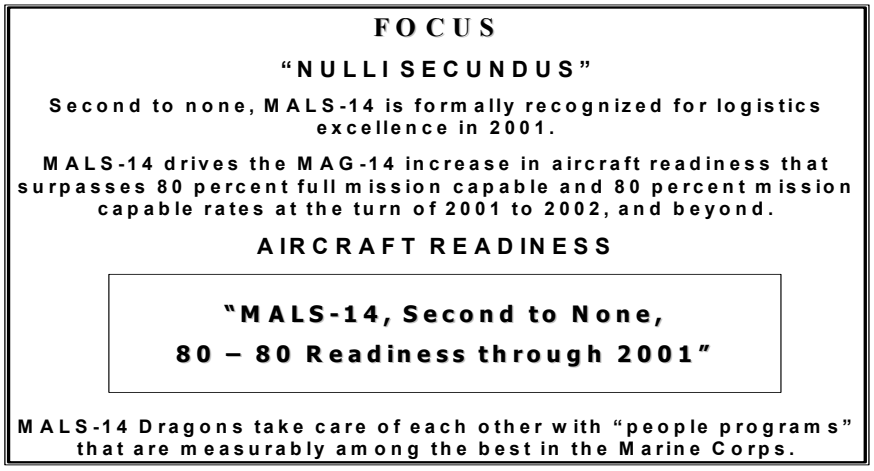

FOCUS
"NULLI SECUNDUS"
Second to none, MALS-14 is formally recognized for logistics excellence in 2001.
MALS-14 drives the MAG-14 increase in aircraft readiness that surpasses 80 percent full mission capable and 80 percent mission capable rates at the turn of 2001 to 2002, and beyond.
AIRCRAFT READINESS
"MALS-14, Second to None,
80 – 80 Readiness through 2001"
MALS-14 Dragons take care of each other with "people programs" that are measurably among the best in the Marine Corps.

Figure 4-4: The Goal – Aircraft Readiness

By formalizing aircraft readiness as the ultimate goal of the organization, all action, performance criteria, decisions, and strategy formulation were focused on aircraft readiness.

The Vision Statement (Figure 4-5) outlined five key principles: (1) Core Values, (2) Balancing People and Purpose, (3) Reinforcing Excellence, (4) a Relentless Positive Approach, and (5) Total Professional Competence.

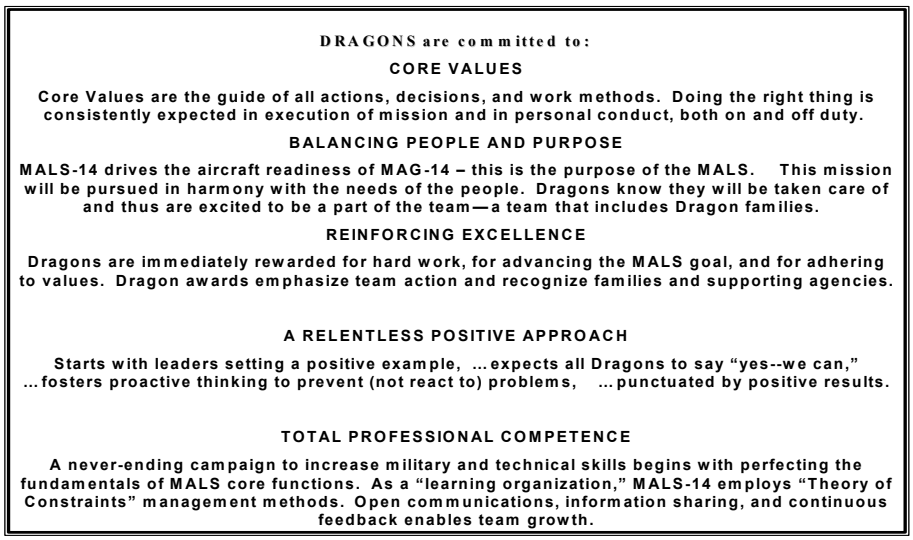

DRAGONS are committed to:
CORE VALUES
Core Values are the guide of all actions, decisions, and work methods. Doing the right thing is consistently expected in execution of mission and in personal conduct, both on and off duty.
BALANCING PEOPLE AND PURPOSE
MALS-14 drives the aircraft readiness of MAG-14 – this is the purpose of the MALS. This mission will be pursued in harmony with the needs of the people. Dragons know they will be taken care of and thus are excited to be a part of the team—a team that includes Dragon families.
REINFORCING EXCELLENCE
Dragons are immediately rewarded for hard work, for advancing the MALS goal, and for adhering to values. Dragon awards emphasize team action and recognize families and supporting agencies.
A RELENTLESS POSITIVE APPROACH
Starts with leaders setting a positive example, ...expects all Dragons to say "yes--we can," ...fosters proactive thinking to prevent (not react to) problems, ...punctuated by positive results.
TOTAL PROFESSIONAL COMPETENCE
A never-ending campaign to increase military and technical skills begins with perfecting the fundamentals of MALS core functions. As a "learning organization," MALS-14 employs "Theory of Constraints" management methods. Open communications, information sharing, and continuous feedback enables team growth.

Figure 4-5: Five Key Principles

First, the principles emphasized the core values (Honor, Courage, Commitment). The core values are central to the Marine ethos, and therefore, provided a philosophical framework from which to take action, make decisions, and work. Second, MALS-14 sought to balance people and purpose substantiating the interdependency of the Marines and their mission. **Without the Marine, the mission doesn't succeed, and without a mission, the Marine has no purpose.** Third, MALS-14 reinforced excellence by rewarding hard work and support of the MALS-14 Vision. Fourth, MALS-14 took a positive, proactive approach starting with sound leadership. Fifth, MALS-14 sought to develop a learning organization focused on professional competence. Figure 4-6 illustrates MALS-14's concept of "Getting the Vision".

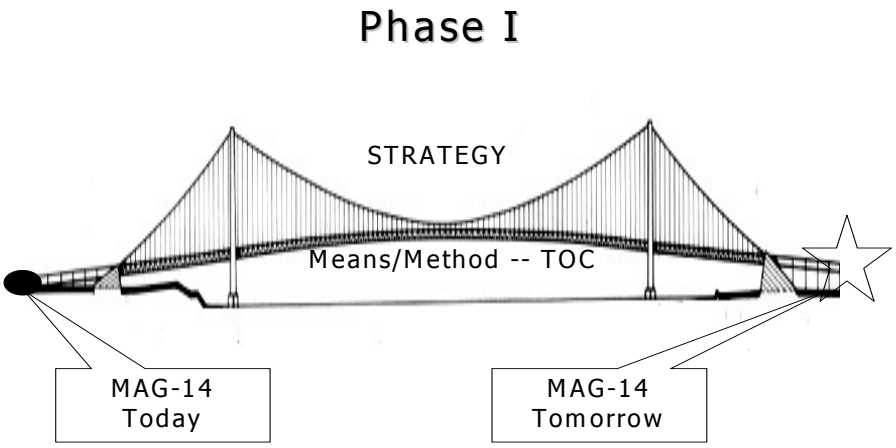


Figure 4-6: Getting the Vision

c. ***Implementation Strategy***

MALS-14 used a policy deployment method to implement their strategic plan. Figure 4-7 illustrates the implementation strategy. The overarching logistics strategic plan published by the Commanding Officer outlined the Vision, goal, and strategy for achieving the goal. The goal(s) specified in the strategic plan became targets for the Department Heads (AMO, ASO, OPSO, etc.). Departments Heads would develop their means and measures for attaining the targets. Thus, the means to achieve a target at

one level became the ends at the level below. Likewise, the measures at one level became the targets at the level below. This implementation strategy aligned the organization (MALS-14) toward the goal (aircraft readiness) and focused human energy toward a desire to change.

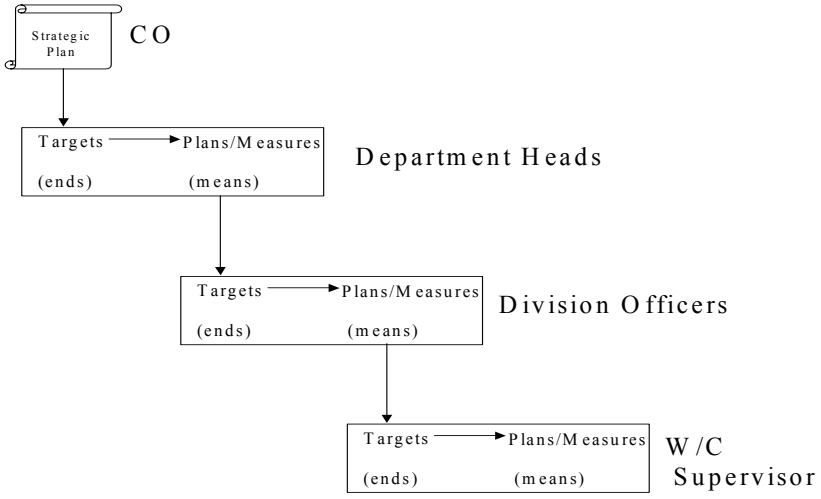


Figure 4-7: Implementation Strategy

2. Phase II - Values Training

Values and leadership training provided the foundation from which MALS-14 could harness the human energy required to make the change process successful. Values training consisted of the Core Values and Leadership Traits and Principles. Values and leadership training was conducted throughout the squadron. Because Marines and Sailors genuinely wanted to do great things, the training generated commitment to the plan, commitment to the goal, and commitment to the success of fellow Marines and Sailors.

3. Phase III - Theory of Constraints Training

The Theory of Constraints was a new concept to the Marines and Sailors of MALS-14. Therefore, MALS-14 had to developed a training plan to teach not only

Theory of Constraints but also Logic Trees. MALS-14 utilized Eli Goldratt's book, *The Goal* and a simulation trainer. Lesson plans were developed using *The Goal* to teach the basic concepts of Theory of Constraints and the Five Focusing Steps. The simulation trainer was a computer-based simulation of a typical production floor. The object of the simulation training was to reinforce the use of the five focusing steps to identify and eliminate constraints within the production line in order to maximize production output and achieve the ultimate goal - making profit.

The training focused on what was wrong with the current management approach to achieving better aircraft readiness, and taught MALS-14 to focus and synchronize their effort on the key constraint to achieving better aircraft readiness. Training emphasized the use of logic trees to identify constraints and map the future success of the organization.

4. Phase IV – Prime Tasks and Metrics

Identifying core competencies and key success factors (metrics) were critical for MALS-14 to construct a strategic plan for success. Core competencies are the things an organization does well (abilities, strengths, etc.) and are the basis for its long-term performance. Critical success factors are those factors that an organization must perform well to be successful or in the case of MALS-14 accomplish its mission. [Ref. 18:p. 290]

MALS-14 used a Future Reality Tree (FRT) to map out core competencies and identify the critical success factors and indicators required to achieve the ultimate goal – aircraft readiness (see Appendix C). The future reality tree served seven basic purposes for MALS-14.

- Enabled MALS-14 to test new ideas before implementation
- Allowed MALS-14 to determine whether the changes would logically produce the desired effects
- Allowed MALS-14 to identify collateral problems created by the changes
- Provided MALS-14 with a means to sustain continuous improvement

- Provided a systems approach to assessing the impact of decisions
- Provided a framework for MALS-14 decision makers to substantiate courses of action with stakeholders (internal and external)
- Served as MALS-14's structured planning system for achieving their ultimate goal (80-80 readiness through 2001)

MALS-14 identified material readiness as the primary core competency for accomplishing their mission and achieving their goal (80-80 readiness through 2001). Initially, MALS-14 defined material readiness as material availability - having "at least" one Supply Officer asset on the shelf at all times. MALS-14 realized material availability depended on allowancing, level of repair, inventory management, maintenance management, manning, test equipment availability, et cetera. This is readily apparent in the FRT (Appendix C). These factors were required to provide sufficiency for the cause and effect relationship of material availability and aircraft readiness. Therefore, the critical success factor for MALS-14 was inventory management. Inventory included repairable and consumable Supply Officer Assets (SOA), both RFI on the shelf and NRFI in the DIFM. **Thus, the two key indicators of material availability were RFI SOA count and DIFM count. If the Supply Officer - working in conjunction with the Aircraft Maintenance Officer - could keep at least one asset on the shelf at all times, material would be available when required by the OMA.**

5. Phase V – Identify the Constraint

MALS –14 identified **material availability as the primary constraint** to aircraft readiness. This seemed to be a self-fulfilling answer to poor readiness. The FRT MALS-14 used to map the process of sourcing, maintaining, and delivering material requirements substantiated cause and effect relationships of material availability. Once the critical success factors were identified for each management level, the leadership used Current Reality Trees (CRT) to identify the root cause of the constraint and used the Five Focusing Steps to eliminate or mitigate the constraint. The critical success factors were

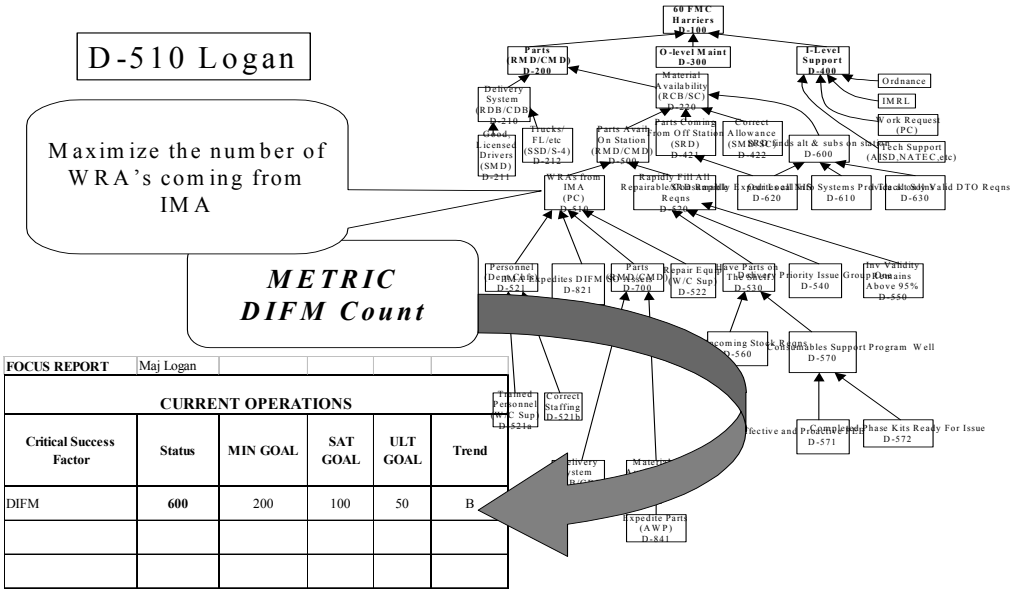
linked directly to providing material availability; and therefore, were linked directly to improving aircraft readiness.

6. Phase VI – An Integrated Reporting System

MALS-14 worked hard to develop a web-based Executive Information System (EIS) that automatically linked the critical success factors to three, One Page Management Reports: Focus Report, what you do; Feedback Report, good and bad news about what you do; and Management Report, good and bad news about what your troops do.

The Focus Report identified the leaders critical success factors and the minimum, satisfactory, and ultimate goals for each success factor. The Feedback Report provided the leader with a daily status of each critical success factor. It was from this report that the leader directed his decisions and action toward constraint management. Figure 4-8 illustrates the use of the Focus Report. This report depicts DIFM count as a critical success factor for maximizing WRA's coming from the IMA. The Management Report provided upstream reporting for departmental and unit level critical success factors. The Management Report was the basis for awards and performance evaluation.

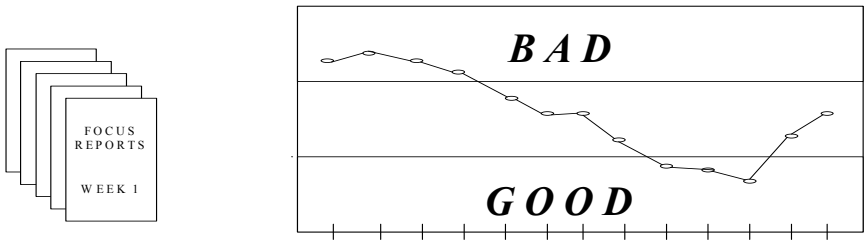
Critical success factors were identified through the use of the MALS-14 FRT and the CRT's used to identify root causes for a constraint. If a constraint was identified but could not be eliminated, the constraint had to be managed; and therefore, the constraint became a critical success factor. Examples of critical success factors were DIFM count, manpower, test bench status, et cetera. Figure 4-8 illustrates how the MALS-14 FRT linked to the reporting system for a specific success factor.


D-510 Logan
Maximize the number of WRA's coming from IMA
METRIC DIFM Count
60 FMC Harriers D-100
Parts RMD/CMD D-200
O-level Maint D-300
I-Level Support D-400
Ordnance
IMRL
Work Request (PC)
Tech Support (ASD,NATEC,etc)
Delivery System (RDB/CDB) D-210
Material Availability (RCB/SC) D-220
Trucks/ FL/etc (SSD/S-4) D-212
Parts Coming From Off Station (SRD) D-423
Correct Allowance (SMR/RCB) D-422
Trained, Licensed Drivers (SMD) D-211
Parts Avail On Station (RMD/CMD) D-500
Rapidly Fill All Repairable Stock Reqns D-520
Systems Prov Tech Valid DTO Reqns D-630
WRAs from IMA (PC) D-510
Personnel (Dem/Val) D-521
IMA Expedites DIFM D-821
Parts RMD/CMD D-700
Repair Equip (W/C Sup) D-522
Have Parts on Delivery D-530
Priority Issue Group Trains D-540
Inv Validity Trains Above 95% D-550
Incoming Stock Reqns D-560
Consumables Support Program Well D-570
Trained Personnel (W/C Sup) D-521a
Correct Staffing D-521b
Complete Phase Kits Ready For Issue D-572
Expedite Parts (AWP) D-841

FOCUS REPORT	Maj Logan				
CURRENT OPERATIONS					
Critical Success Factor	Status	MIN GOAL	SAT GOAL	ULT GOAL	Trend
DIFM	**600**	200	100	50	B

Figure 4-8: FRT Links to Reporting System

The focus report was linked to performance charts for the specific critical success factor illustrated by Figure 4-9.



FOCUS REPORT	NCO2				
CURRENT OPERATIONS					
Critical Success Factors	Status	MIN GOAL	SAT GOAL	ULT GOAL	Trend
PD-330 JC/SOIOU PDs	**8**	5	3	0	B

Figure 4-9: Performance Charts

Performance charts tracked the status of the critical success factor against the minimum, satisfactory, and ultimate goals. Figure 4-9 shows the work center focus

report. The critical success factor was primary degraders with a status JC/SOIOU (Job Complete/Supply Officer IOU). These were primary degraders that had been repaired but not returned to the warehouse as stock.

By establishing a range of targets, the work center supervisor could take the necessary action required to keep JC/SOIOU's below five. A status greater than five was reported to the next higher echelon (Division) after a specified time period (3 reporting periods). Some reporting periods were daily while others were weekly and even monthly. The reporting period depended on the nature of critical success factor and was determined during policy deployment. After a number of reports had been gathered, MALS-14 developed trend reports. Figure 4-10 is an example of a trend report.

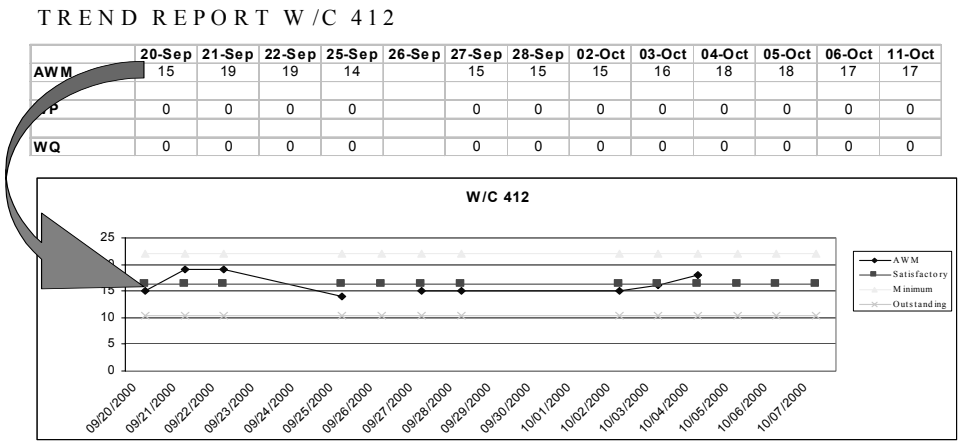


Figure 4-10: Trend Report

These reports helped assess work center performance, identify constraints such as training deficiencies, and identify scheduling conflicts. The reporting system as a whole provided the leadership with a decision support tool that linked the MALS-14 strategic plan to the decisions and actions needed to drive success.

7. Phase VI – Manage by TOC Methodology

The final phase of MALS-14's Strategic Plan was management by Theory of Constraints methodology. This meant full implementation of the use of logic trees to

identify constraints and utilization of the Five Focusing Steps in conjunction with the reporting system to eliminate or manage the constraint. Figure 4-11 depicts the two-prong approach of the MALS-14 Strategic Plan.

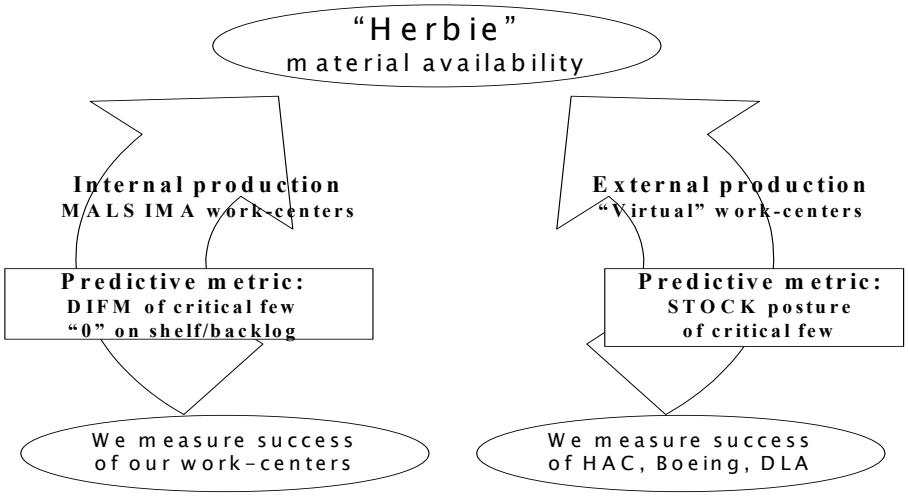


Figure 4-11: MALS-14 Two-pronged Approach

D. SUMMARY

MALS-14 established crystal-clear goals, developed a strategy to achieve the goals, and implemented a reporting system to manage critical success factors. The aim was to integrate critical processes of the squadron toward a common goal. The key was to capitalize on the power of ownership. Every leader was instrumental in the development of his or her strategy to achieve the ultimate goal of the squadron. MALS-14 was able to cut through the complex world of Aviation Logistics and focus the effort of the leaders and processes toward its goal. MALS-14 used sound leadership, strategic thinking, and the Theory of Constraints to develop a strategic plan and feedback system to improve aircraft readiness. In November 2001, MAG-14 achieved 82 percent readiness. Additionally, MALS-14 was selected as the Marine Aviation Squadron of the Year 2001.

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V. RECOMMENDED PERFORMANCE METRICS

A. OVERVIEW

In analyzing MALS-14's efforts in improving aircraft readiness within MAG-14, we realized the current aviation logistics performance metrics and culture can potentially prohibit the MALS from effectively contributing to sustaining and improving aircraft readiness. Specifically in MALS-14's case, MAG-14 readiness suffered over a significant timeframe despite the indication the MALS was performing successfully according to legacy metrics (e.g., Supply Effectiveness, Turn-Around-Time, Beyond-Capability of Maintenance rates, etc). MALS-14's use of a strategic logistics management plan focused on tying the organization's vision, ultimate goal, and logistics performance with aircraft readiness significantly improved MAG-14's Full Mission Capable and Partial Mission Capable rates. Utilizing lessons learned from the MALS-14 case study analysis, new performance metrics based on the overarching principles of SCM can be implemented via a strategic logistics management plan and policy deployment method to maximize any MALS's contribution to optimizing aircraft readiness within a Marine Aircraft Group.

B. RECOMMENDED PERFORMANCE METRICS

Before defining specific performance metrics, we refer back to MALS-14's "Future Reality Tree" (Figure 5-1) to focus on activities within the MALS that "own" aircraft readiness. As stated in chapter 4, ***Material Readiness*** was the primary core competency of MALS-14 tied to achieving the ultimate goal of "80/80 readiness through 2001." As a result, the primary critical success factors tied to aircraft readiness and material readiness were ***inventory and production management***. Logistics Responsiveness and Material Availability were key conditions for achieving success. Logistics Responsiveness was simply expeditiously delivering parts to the customer when requested, and material availability was comprised of 1) ensuring at least one part was available for issue off the shelf and 2) reducing DIFM material (due-in-from-maintenance

or work in process inventory). Referring back to chapter 2, these concepts follow the adapted SCOR logistic performance metrics of ***Supply Chain Response Time and Perfect Order Fulfillment***.

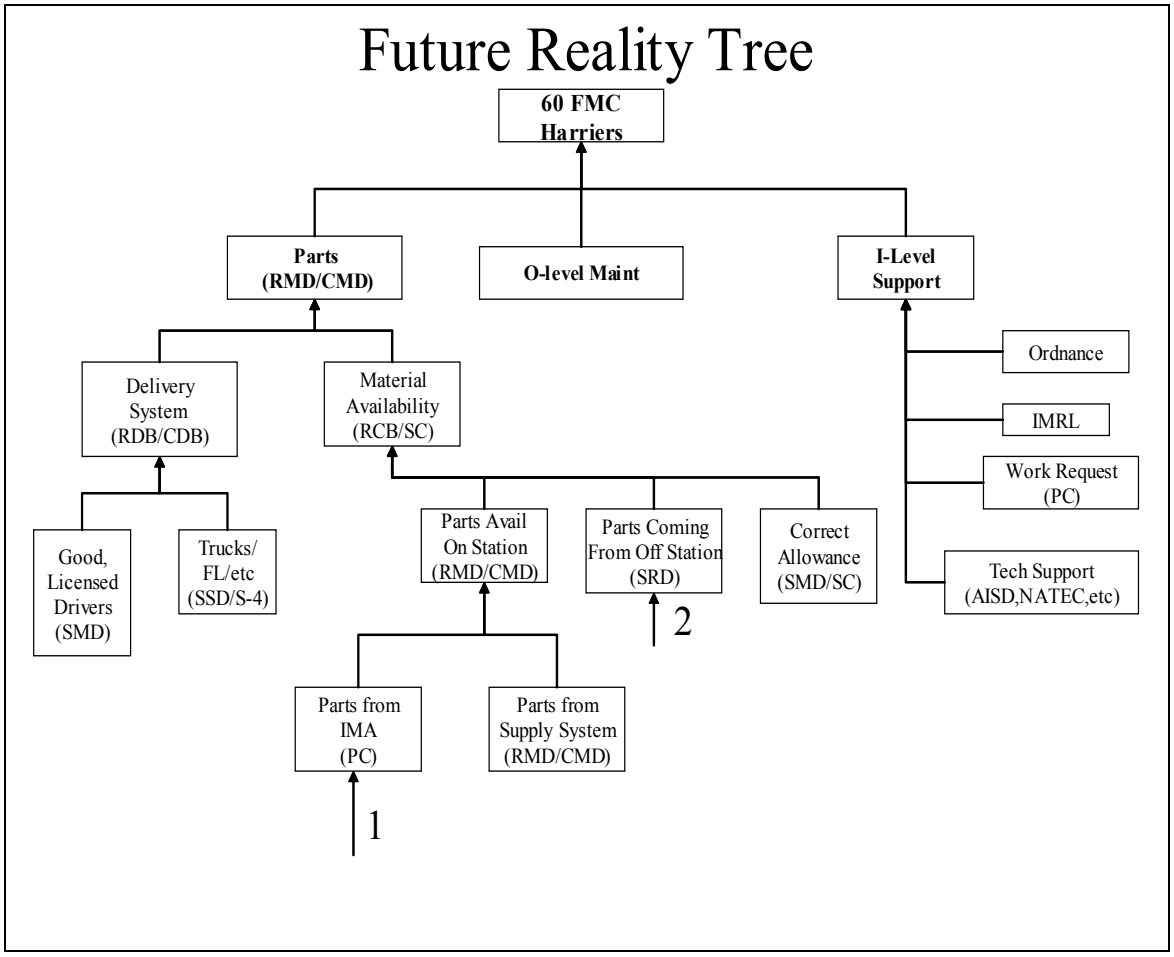


Figure 5- 1 MALS-14 Future Reality Tree for Integrated Aviation Logistics Performance

Performance begins with the organization's ultimate goal of 60 Fully Mission Capable AV-8B Harriers, or more precisely, 80% Full Mission Capable and 80% Partial Mission Capable aircraft by 2001. The associated adapted SCOR model performance metric identified earlier in chapter 2 that is most closely related to what MALS-14 did here is measuring the **Operational Availability (A_o) or the weapon system's Non-Mission Capable (NMC) rates (opposite of FMC rate)**. The overall goal is to minimize aircraft NMC time, and maximize aircraft A_o. In order to accomplish this

daunting task, the following three aviation logistics processes must be coordinated in a cross-functional and integrated fashion:

- **Material Readiness or Parts Management (the primary focus of performance measurement in this chapter)**
- O-Level Maintenance
- I-Level Support

Utilizing MALS-14's "Future Reality Tree," the following performance metrics (Table 5-1) can be applied (via the policy deployment method identified in chapter 4) to the above processes and corresponding functional and sub-functional activities used to optimize the performance of the MALS aviation logistics supply chain:

Owner / **Process**	MALS ASD RMD (RDB/RSB/RCB /AWPB)	MALS ASD CMD (CDB/CSB/SRB/ PEB/CCB)	MALS ASD SRD (TRB/ERB)	MALS AMD IMA PC	MALS AMD IMA Division/Work Center
Inventory Management	Perfect Order Fulfillment	Perfect Order Fulfillment	Perfect Order Fulfillment	Perfect Order Fulfillment	Perfect Order Fulfillment
DIFM Management	DIFM Count	DIFM Count	DIFM Count	DIFM Count	DIFM Count
Responsiveness	Supply Chain Response Time	Supply Chain Response Time	Supply Chain Response Time	Supply Chain Response Time	Supply Chain Response Time

Table 5- 1 MALS Supply Chain Management Performance Metrics

C. RESPONSIVENESS

1. Responsiveness Metric

The SCOR model metric used to manage ***responsiveness*** is "Measure Supply Chain Response Time." This metric is not used by the MALS in current aviation logistics doctrine. The current aviation logistics management information systems also do not provide broad or detailed calculations of supply chain response time. If a MALS wishes to measure Supply Chain Response Time, it has to tailor specially written ad-hoc reports to extract requisition transaction history information from R-Supply. In this case, the Supply Chain Response Time value merely represents the total time from initiation of the requisition (requisition julian date) to completion of the requisition in R-Supply. This time measurement does not provide any details on the time the requisition spends at different links in the Naval/Marine Corps aviation logistics supply chain.

Measuring and reducing supply chain response time directly increases aircraft Operational Availability. Aircraft Operational Availability is defined as $A_o = \frac{MTBM}{MTBM + MDT}$ where MTBM in the Mean-Time-Between-Maintenance and MDT is the total Maintenance Downtime. MDT is a function of active maintenance time ($\overline{M}$), Logistics Delay Time (LDT), and Administrative Delay Time (ADT). LDT is that part of MDT that is attributed to waiting for a spare part to become available (Ref. 19:p. 57). MDT for MALS aviation logistics operations can be redefined as the average Logistics Response Time (LRT) and/or average Customer Wait Time (CWT). We define LRT as the total average time spent "on-station" from initiation of a squadron's requisition (e.g., N601 transmitted in Optimized OMA NALCOMIS) to the delivery and completion of that requisition (e.g., N615 Proof of Delivery completed in Optimized IMA NALCOMIS). We also define Customer Wait Time as the total average time spent processing a customer's requisition "on-station" (e.g., N601 initiated, requisition processed as a "not-in-stock," "not-carried," or beyond the IMA's repair capability of-maintenance and referred to upstream members of the Naval/Marine Corps aviation logistics supply chain for action) and ultimately satisfying that requisition from "off-station" or upstream

members of the Naval/Marine Corps aviation logistics supply chain (e.g., N615 Proof of Delivery completed in Optimized IMA NALCOMIS).

We contend LRT and CWT are the most significant metrics the MALS can utilize to improve aircraft A_o ***with respect to responsiveness***. One specific example of a MALS utilizing LRT as a performance metric to improve aircraft readiness was at MALS-14. The largest *perception* among the Organizational Maintenance Activities in MAG-14 was poor delivery time (only one fraction of total LRT) from MALS-14 when a squadron ordered a repairable component. The chief complaint from the squadron Maintenance Material Control Officers in MAG-14 was that when a requisition was ordered for a part that was "in-stock" in the MALS Repairables Management Division, the status of the requisition remained "ISSIP" (issue-in-process) far too long. The RMD Officer at MALS-14, First Lieutenant Bert Cruz, and his Staff Non-Commissioned Officer in Charge (SNCOIC), conducted an in-depth covert analysis of their Repairables Storage Branch (RSB) and Repairables Delivery Branch (RDB) operations to determine what the average delivery statistics were for satisfying repairable requirements for MAG-14 squadrons. The RDB for the MALS-14 Aviation Supply Department consisted of six enlisted delivery drivers and one SNCOIC. First Lieutenant Cruz and his SNCOIC spent six hours a day during March, 2001 observing all activities of the RDB including time spent during "smoke breaks" and lunch breaks, types of vehicles used, delivery routes used, turn-over routines between all three shifts (MALS-14 RMD operated 24 hours a day on three 8-hour shifts), and time spent inducting not-ready-for-issue (NRFI) repairable components into the MALS repair cycle. First Lieutenant Cruz concluded that the perception of poor delivery response times was unfounded, and that MALS leadership needed to focus its attention elsewhere to identify the true constraint in the MALS repair cycle. (Ref. 20) The average delivery response time (from the time a requisition "picking ticket" printed in the warehouse to delivery) during this evolution was roughly 55 minutes (see Table 5-2), which was within the one hour response time standard (OPNAVINST 4441.12C dated 26 Oct 1999).

MALS-14 Repairables Management Division		
Delivery Time Analysis		
29-Mar-01		
March	**# of Requisitions**	**Mean Delivery Time (In Minutes)**
1	19	**68.42**
4	29	**68.2**
5	36	**43.72**
6	28	**44.35**
7	23	**37.13**
8	37	**44.18**
11	19	**44.52**
12	33	**56.84**
13	NALCOMIS CRASH	**N/A**
14	13	**66.69**
15	22	**68.22**
18	13	**43.61**
19	18	**60.5**
20	18	**79.66**
21	29	**62.13**
22	26	**54.8**
25	17	**38.41**
26	15	**46.53**
27	28	**54.25**
28	24	**51.12**
	Total	**54.38**

Table 5- 2 MALS-14 Delivery Time Analysis

First Lieutenant Cruz's example of measuring delivery response times is only one portion of the LRT metric. In order to best gauge the performance of the MALS, as well as identify constraints to ***supply chain response time***, more than delivery response time must be measured. All aspects of Logistics Response Time (elapsed time spent processing "on-station" requirements) and Customer Wait Time (elapsed time spent processing "off-station" requirements) should be evaluated. As of now, measuring the total average supply chain response time (e.g., LRT and CWT) is not a MALS performance metric. Based on guidance provided in the Fiscal Year 2000 and 2001 DoD Strategic Logistics Plans, and the DoD Instruction 4140.61 (Customer Wait Time and Time Definite Delivery) dated December 14, 2000, we propose ***supply chain response time*** (LRT and CWT) should be a metric integrated between the strategic level of

logistics (e.g., NAVICP, DLA, etc) to the tactical level of logistics (e.g., MALS). For this metric to be most effective, Logistics Response Time and Customer Wait Time should be an integrated performance metric embedded within not only existing MALS aviation logistics management information systems (e.g., NALCOMIS, R-Supply, etc), but also with logistics management information systems of the upstream members of the Naval/Marine Corps aviation logistics supply chain (e.g., the FISC, DLA, NAVICP-P, Defense Distribution Depots, etc.)

The future challenge for this metric is to track the total average customer wait time or on-station logistics response time for an individual part, vice the aggregation of all requirements for all parts from squadrons processed through the MALS. The MALS, and all upstream members of the Naval/Marine Corps aviation logistics supply chain, can bring resources to bear on problematic parts that are not meeting supply chain response time standards in order to increase aircraft readiness. Table 5-3 shows time standards for upstream elements in the supply chain according to DoD Regulation 4140.1-R, Material Management Regulation.

	Area (CONUS)
Pipeline Segment	**Time Standard (Days)**
Requisition submission time	.5
ICP processing time	.5
Storage site (or base): processing, packaging, and transportation hold time	1
CONUS in-transit time	1
Receipt take-up time	.5
Total order-to-receipt time	**3.5**

Table 5- 3 IPG-1 (NMCS/PMCS) UMMIPS Time Standards (from Ref. 21:App. 8)

Of particular importance is that for NMCS/PMCS requirements referred to the upstream members of the Naval/Marine Corps aviation logistics supply chain, the total customer wait time standard is 3.5 days (DoD UMMIPS goal). The internal DoN customer wait time requirement is 24 hours if the supply supporting activity is within 35 miles of the requisitioning activity, and 23 days for all other requirements submitted to upstream suppliers (OPNAVINST 4441.12C dated 26 Oct 1999). Stated in other terms, the MALS "owns" merely 1 hour of aircraft readiness downtime associated with waiting for spare parts to be issued that were available in inventory (54 minutes on average for MALS-14 repairables), while the rest of the supply chain "owns" a variation of aircraft readiness downtime awaiting issuance of parts from upstream supplier's inventories depending on which standard is applied (24 hours within 35 miles, 23 days for all activities, or the DoD UMMIPS standard of 3.5 days). An analysis of the Defense Logistics Agency's "Logistics Metrics Analysis Reporting System," a web-based Customer Wait Time database used for analyzing Customer Wait Time trends throughout DoD, revealed interesting results. The Atlantic Fleet's Issue Priority Group 1 requisitions (including 2d MAW MALS NMCS/PMCS requisitions) processed during the month of July, 2002 revealed the average customer wait time for 1,305 wholesale level requisitions processed (compiled of immediate issues, backorders, planned direct vendor deliveries, unplanned direct vendor deliveries, and other pipeline activity reports) was ***36.8 days***. (Ref. 22)

Although this figure represents a group of activities more than just the east-coast based Marine Aviation Logistics Squadrons (including MALS-14) and the Marine squadrons they are supporting (including MAG-14 squadrons), the important point remains that the overall average represents a much longer average wait time than the average 3.5 day goal for IPG-1 requisitions. By utilizing the ***responsiveness metric***, we realize the average customer wait time of 36.8 days represents a much greater potential impact of the Logistics Delay Time (LDT) of the upstream members of the supply chain on aircraft readiness.

The lesson learned in this example is that the MALS only truly "owns" a small amount of LDT compared to that of the upstream members of the supply chain. Marginal improvements in LRT by the MALS will not drastically improve aircraft readiness within the MAG, but rather marginal improvements in reducing CWT should result in larger improvements in aircraft readiness. Upstream members of the supply chain ***must*** take responsibility of excessive CWT for individual parts degrading unit readiness, and not continue to analyze CWT in aggregate (e.g., individual requirements for an individual squadron or MALS vice all requirements for the entire Atlantic Fleet). Current reporting requirements and data analysis of the LMARS system does not support in-depth analysis of the total average CWT of only MALS-14's requisitions, which is outside the scope of this thesis. We recommend this as a potential follow on thesis topic for the ***"supply chain response time"*** or ***responsiveness metric***. Customer Wait Time (in aggregate) is currently a primary readiness metric employed by "Producers" Customer Focus Team (CFT-2) of the Naval Aviation Readiness Improvement Team (NAVRIT). Figure 5-2 is the "Planeside Integrated Logistics Support" Summary Chart which defines the goals for average customer wait time metric for a squadron or air station.

Planeside Summary

Planeside Performance Summary				
Planeside Performance (NMCS/PMCS)	GOAL	GREEN	YELLOW	RED
Percentage First Day Issue	75%	75% OR ABOVE	> 70% & < 75%	70% AND BELOW
Average Customer Wait Time (ACWT)	4 D	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Consumable ACWT (NMCS/PMCS)	4 D	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Repairable ACWT (NMCS/PMCS)	4 D	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Sustainability				
RMS/PEB fills as a % of consumable RQNS	25%	25% OR ABOVE	< 25% & > 20%	20% AND BELOW
Wholesale Stock ACWT				
Repairable	23 D	23 DAYS OR LESS	> 23 & < 29 DAYS	29 OR > DAYS
Consumable	23 D	23 DAYS OR LESS	> 23 & < 29 DAYS	29 OR > DAYS
Unfilled Initial Issues	N/A			
Production				
WRA TAT (excluding 400)	6.9 D	7 DAYS OR <	> 7 & < 11 DAYS	11 OR > DAYS
Engine Cycle Time	25 D	25 DAYS OR <	> 25 & < 31 DAYS	31 OR > DAYS
Repair Rate (All BCM)	N/A			
Repair Rate (Less BCM-1)	80%	80% OR ABOVE	> 75% & < 80%	75% AND BELOW
Production Resources (non-engine)				
Percentage First Day Issue AWP	75%	75% OR ABOVE	> 70% & < 75%	70% AND BELOW
ACWT AWP (non-engine)	4 D	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Consumable ACWT AWP (non-engine)	4 D	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Repairable ACWT AWP (non-engine)	4 D	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
ACWT AWP (engine)	4 D	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Consumable ACWT AWP (engine)	4 D	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Repairable ACWT AWP (engine)	4 D	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Manning Posture				
CORE Rating COB as a percentage of BA	100%	90% OR ABOVE	> 80% & < 90%	80% AND BELOW
CORE Rating DNEC/MOS as a percent of BA	100%	90% OR ABOVE	> 80% & < 90%	80% AND BELOW
ASD Manning (Civilian/Mititary)	100%	90% OR ABOVE	> 80% & < 90%	80% AND BELOW
Aircraft, Engine and Support Equipment Inventory				
PAI as a percent of PAA	100%	90% OR ABOVE	> 80% & < 90%	80% AND BELOW
Bare Firewalls	0	AT GOAL	1-5	>5
Broad Arrows	N/A			
CAT I TPDR Cycle time	7 D	7 DAYS OR LESS	> 7 & < 12 DAYS	12 OR > DAYS
IRAC Cycle Time	35 D	35 DAYS OR LESS	> 35 & < 45 DAYS	45 OR > DAYS

Figure 5- 2 Planeside Summary Chart (from Ref. 23)

2. Logistics Assets

These are the vehicles, material handling equipment (MHE), and Support Equipment (SE) the Aviation Supply and Aircraft Maintenance Departments utilize to respond to a squadron's aviation logistics requirements. Ensuring that sufficient MHE/SE assets are available is crucial to ensuring the MALS can provide ***responsive*** aviation logistics support. SE is organic to the MALS, and is their responsibility to maximize availability (e.g., Pettibone crane). Ensuring MHE and light-, medium-, and heavy-lift Motor Transport (MT) asset availability requires coordinating efforts with the MALS S-4 (Logistics Department), MAG S-4 (Logistics Department), Marine Wing Support Squadron Motor Transport Operations Division (Ref. 24:p. 2-23), and in certain arrangements, the Marine Corps Air Station/Naval Air Station Supply Department's

Transportation Division. **Sub-Metric: Asset Readiness or Operational Availability (A_o).**

3. Personnel

Even with 100% availability of transportation and MHE/SE assets, a MALS can fail in providing ***responsive*** aviation logistics support if there is a manpower shortage or training and certification deficiencies. Aviation logistics leadership within the MALS should focus on the personnel readiness of their work centers, divisions, and departments in order to provide the "human factor" of ***responsive*** aviation logistics support. **Sub-Metric: Personnel Readiness**.

D. MATERIAL AVAILABILITY (INVENTORY AND DIFM MANAGEMENT)

1. Material Availability Metric: Perfect Order Fulfillment

"Perfect Order Fulfillment" is defined as the ratio of perfectly satisfied orders to total orders measured. From the squadron's perspective, the most important orders are those that are directly tied to aircraft readiness. Requisitions that are processed for NMC aircraft are the single most important requirements to satisfy. As a result, and as indicated in MALS-14's Future Reality Tree, inventory and DIFM management become the performance metrics for the Aviation Supply and Aircraft Maintenance Department of the MALS directly tied to improving aircraft readiness. Unfortunately, current MALS performance metrics do not correlate trends between improved inventory and production management with decreased aircraft readiness (e.g., Supply Effectiveness and Turn-Around-Time). As explained in chapter 4, supply effectiveness and TAT trends may be meeting policy goals, but aircraft readiness could be declining or well under established readiness goals. Table 5-4 displays the recommend MALS material availability performance metrics under the SCM metric of "perfect order fulfillment" to better correlate between the MALS' inventory and production management efforts and improving aircraft readiness:

	Old Efficiency Metrics	New Readiness-Based Metrics
ASD/RMD	Repairable Net/Gross Supply Effectiveness	Repairable Net/Gross NMCS/PMCS Supply Effectiveness
ASD/CMD	Consumable Net/Gross Supply Effectiveness	Consumable Net/Gross NMCS/PMCS Supply Effectiveness
AMD/ASD	Turn-Around-Time (TAT)	DIFM count (Overall and for Primary Readiness Degraders)
ASD	Entire Inventory Range/Depth	RMD: R-Pool Range and Depth Percentage and Inventory "Holes" Count (Zero On Hand Available for Issue) CMD: Readiness-Critical Inventory Range and Depth

Table 5- 4 MALS Material Availability Metrics

2. Allowance Management

The first of three elements to "material availability" begins with ***allowance management***. Without proper allowance management, the MALS will always be fighting a losing battle with regards to sustaining aircraft readiness. Current material management policy for MALS allowance management is contained in the Aviation Supply Desktop Procedures (MCO P4400.177C). The MALS Supply Management, Repairables Management, and Consumables Management Divisions all share a great deal of responsibility in ensuring the proper inventory levels within the MALS ASD to support their customers. In the case of internal allowance reviewing performed by the individual MALS, repairable allowances are reviewed at a minimum on a quarterly basis for allowance increases, decreases, additions, and deletions. (Ref. 25:p. 4-19) Consumable inventory level settings are directed by the cognizant Marine Aircraft Wing and/or Naval Aviation Type Commander. (Ref. 25:p. 6-40) From our experience,

consumable level settings are usually reviewed and adjusted for demand at a minimum, once a quarter, but usually performed on a monthly basis. The Supply Management Division (SMD) also coordinates with both RMD and CMD on the frequency and validity of their inventory management level setting and allowance change review efforts. Specifically, SMD performs Repairable Asset Management Assist Team (RAMAT) reviews either with the assistance of the Naval Inventory Control Point-Philadelphia, or on their own accord. The RAMAT program, is a detailed allowance reconciliation with the planned program requirements (PPR) inventory records held officially at NAVICP-P. This effort ensures the allowances on their inventory records are the same as reflected in the PPRs on file with NAVICP-P. (Ref. 25:p. 4-20)

In order for the MALS ASD and AMD to gauge whether proper allowancing is being performed by the inventory managers, the Supply Effectiveness metric is a good tool for determining how well the supply department, as a whole, is satisfying customer demand. To better gauge how well an inventory is performing with respect to satisfying aircraft readiness degrading requirements, the MALS should use a more defined metric other than overall net and gross supply effectiveness. The MALS should analyze the fill rate effectiveness of NMCS/PMCS demands. This new metric, NMCS/PMCS supply effectiveness, will provide MALS aviation logisticians a snapshot of how well (or not so well) their inventory is supporting aircraft readiness. NAVRIT currently is using a similar metric that focuses on the NMCS/PMCS fill rate for first-day issues (see Figure 5-2).

3. On-Station Material Availability

Metrics: inventory management (parts coming from the aviation supply department) and DIFM count (parts coming from the IMA). The second element of "material availability" is "on-station material availability." To optimize overall material availability, proper allowance management must also be coupled with "on-station" and "off-station" material availability. On-station material availability, as depicted in Figure 5-1, is defined as "parts coming from the aviation supply department" and "parts coming from the Intermediate Maintenance Activity or IMA."

a) Inventory Management (Parts Provided by the Aviation Supply Department)

Metrics: NMCS/PMCS Supply Effectiveness, R-Pool Range and Depth (RMD), and Readiness-Critical Inventory Range and Depth (CMD) The traditional performance metric for the aviation supply department with reference to inventory management is the "Range and Depth" metric. **Range** corresponds to the number of line items of material stocked. To increase the range of stock is to add new line items of material to the inventory. The "Range" metric describes the percentage of items in the inventory that have on hand assets greater than or equal to the requisitioning objective (the typical goal is 90%). **Depth** corresponds to the quantity of a specific part (NSN) carried in stock. Increasing the depth of stock is increasing the quantity on hand. The "Depth" metric describes the percentage of items in the inventory that have on hand assets greater than zero (the typical goal is 87%).

With MALS-14, their primary goal was to ensure at least one repairable part was on the shelf for parts that were constraining aircraft readiness. Although the "Range and Depth" metric gives you a snapshot of the overall material availability of the inventory, it does not provide any indication how well ***inventory management*** is sustaining aircraft readiness. One possible method of improving the traditional range and depth metric is to adapt it to evaluate the range and depth of "readiness driving" parts in the supply officer's inventory. The Navy utilizes the Local Repair Cycle Asset (LRCA) or Rotatable Pool (R-Pool) concept to segregate the supply officer's inventory to better manage readiness degrading repairable parts. Measuring the range and depth of the LRCA/R-Pool should also be coupled with a metric that measures "holes on the supply officer's shelf." This metric would provide a list of those parts that have zero RFI assets on the shelf (minus the FISP assets). We recommend the MALS use the Navy's Local Repair Cycle Asset (LRCA) or Rotatable Pool (R-Pool) concept. The LRCA/R-Pool concept can be summarized as intense micro-management of the most routinely ordered readiness impacting repairables which the IMA is capable of repairing. The Navy's R-Pool range and depth goals are 100% and 96% respectively. (CNAPINST 4423.8C dated March 21, 2000) The MALS should also focus on the allowance levels and range and

depth percentages of "readiness-critical" consumable parts that are aircraft NMCS/PMCS requirements or are used in repair of NMCS/PMCS repairable components in the MALS repair cycle. This would include consumable parts in the supply officer's inventory as well as consumable parts located in squadron and IMA pre-expended bins.

Another metric that correlates inventory management with aircraft readiness under the SCM measurement of "Perfect Order Fulfillment" is the NMCS/PMCS Supply Effectiveness metric mentioned earlier under "allowance management." This metric indicates positive or negative ***trends*** in inventory management. Poor (good) allowancing and inventory management will directly result in low (high) NMCS/PMCS supply effectiveness. The MALS should use the NMCS/PMCS supply effectiveness metric to identify those parts that are causing low effectiveness rates and degrading aircraft readiness. Data collected from MALS-26 (July, 2001 to July, 2002) displays how the NMCS/PMCS supply effectiveness metric can vary significantly from the traditional supply effectiveness metric (Table 5-5).

Repairables	**Average**	**Goal**
Net Supply Effectiveness	80.11%	85.00%
NMCS/PMCS Net Effectiveness	59.98%	85.00%
Gross Supply Effectiveness	76.16%	75.00%
NMCS/PMCS Gross Effectiveness	58.21%	75.00%
Consumables	**Average**	**Goal**
Net Supply Effectiveness	87.81%	85.00%
NMCS/PMCS Net Effectiveness	64.11%	85.00%
Gross Supply Effectiveness	78.13%	75.00%
NMCS/PMCS Gross Effectiveness	62.42%	75.00%

Table 5- 5 MALS-26 NMCS/PMCS Supply Effectiveness Comparison

The 2nd Marine Aircraft Wing Aviation Logistics Department currently utilizes a similar NMCS/PMCS supply effectiveness metric. Table 5-7 and 5-8 are the NMCS/PMCS supply effectiveness summaries for the month of June, 2002 for MAG-26 squadrons and type-model-series aircraft respectively.

MAG-26 SQUADRON NMCS/PMCS Summary

Report Period: June 2002

NMCS

	MALS SUPPLY ACTION					MALS MAINT ACTIONS							
			CONSUMABLE	REPAIRABLE									
		ISSUED	PASS TO	PASS TO	SUPPLY			EXREPS			IMA	CONSUMABLE	REPAIRABLE
SQUADRON	RQMT	FROM STK	SYSTEM	MALS MAINT	EFFECT	INDUCTS	AUTO BCM	EXREP	REPAIR	BCM	EFFECT	RQMT	RQMT
HMH461	252	168	76	8	66.67%	8	3	5	2	3	40.00%	226	26
HML167	191	139	43	9	72.77%	9	0	9	4	5	44.44%	161	30
HMM261	0	0	0	0	0.00%	0	0	0	0	0	0.00%	0	0
HMM264	208	155	41	12	74.52%	12	3	9	3	6	33.33%	156	52
HMM266	164	134	23	7	81.71%	7	1	6	4	2	66.67%	135	29
HMT204	10	3	7	0	30.00%	0	0	0	0	0	0.00%	10	0
TOTALS	825	599	190	36	72.61%	36	7	29	13	16	44.83%	688	137

PMCS

	MALS SUPPLY ACTION					MALS MAINT ACTIONS							
			CONSUMABLE	REPAIRABLE									
		ISSUED	PASS TO	PASS TO	SUPPLY			EXREPS			IMA	CONSUMABLE	REPAIRABLE
TMS	RQMT	FROM STK	SYSTEM	MALS MAINT	EFFECT	INDUCTS	AUTO BCM	EXREP	REPAIR	BCM	EFFECT	RQMT	RQMT
HMH461	83	54	22	7	65.06%	7	2	5	4	1	80.00%	63	20
HML167	66	40	18	8	60.61%	8	5	3	0	3	0.00%	47	19
HMM261	0	0	0	0	0.00%	0	0	0	0	0	0.00%	0	0
HMM264	90	67	8	15	74.44%	15	5	10	8	2	80.00%	51	39
HMM266	32	24	5	3	75.00%	3	1	2	1	1	50.00%	19	13
HMT204	0	0	0	0	0.00%	0	0	0	0	0	0.00%	0	0
TOTALS	271	185	53	33	68.27%	33	13	20	13	7	65.00%	180	91
MAG TOTALS	**1096**	**784**	**243**	**69**	71.53%	**69**	**20**	**49**	**26**	**23**	**53.06%**	**868**	**228**

Table 5- 6 MAG-26 NMCS/PMCS Summary Report by Squadron (from Ref.26)

MAG-26 TMS NMCS/PMCS Summary

Report Period: June 2002

NMCS

	MALS SUPPLY ACTION					MALS MAINT ACTIONS							
			CONSUMABLE	REPAIRABLE				EXREPS			IMA	CONSUMABLE	REPAIRABLE
TMS	RQMT	ISSUED FROM STK	PASS TO SYSTEM	PASS TO MALS MAINT	SUPPLY EFFECT	INDUCTS	AUTO BCM	EXREP	REPAIR	BCM	EFFECT	RQMT	RQMT
UH1N	56	34	16	6	60.71%	6	0	6	2	4	33.33%	49	7
AH1W	178	136	37	5	76.40%	5	1	4	2	2	50.00%	147	31
CH46E	299	240	44	15	80.27%	15	2	13	7	6	53.85%	228	71
CH53E	282	186	86	10	65.96%	10	4	6	2	4	33.33%	254	28
MV22	10	3	7	0	30.00%	0	0	0	0	0	0.00%	10	0
TOTALS	815	596	183	36	73.13%	36	7	29	13	16	44.83%	678	137

PMCS

	MALS SUPPLY ACTION					MALS MAINT ACTIONS							
			CONSUMABLE	REPAIRABLE				EXREPS			IMA	CONSUMABLE	REPAIRABLE
TMS	RQMT	ISSUED FROM STK	PASS TO SYSTEM	PASS TO MALS MAINT	SUPPLY EFFECT	INDUCTS	AUTO BCM	EXREP	REPAIR	BCM	EFFECT	RQMT	RQMT
UH1N	30	17	8	5	56.67%	5	3	2	0	2	0.00%	20	10
AH1W	51	36	12	3	70.59%	3	2	1	0	1	0.00%	36	15
CH46E	84	59	9	16	70.24%	16	5	11	8	3	72.73%	42	42
CH53E	106	73	24	9	68.87%	9	3	6	5	1	83.33%	82	24
MV22	0	0	0	0	0.00%	0	0	0	0	0	0.00%	0	0
TOTALS	271	185	53	33	68.27%	33	13	20	13	7	65.00%	180	91
MAG TOTAL	**1086**	**781**	**236**	**69**	**71.92%**	**69**	**20**	**49**	**26**	**23**	**53.06%**	**858**	**228**

Table 5- 7 MAG-26 NMCS/PMCS Summary Report by Aircraft Type (from Ref. 26)

b) DIFM Management (Parts Provided Jointly by the Aircraft Maintenance and Supply Departments)

Metric: DIFM count. Reducing the overall DIFM count ultimately results in more repairable assets on the supply officer's shelves, and fewer aircraft downed for lack of spare parts. Utilizing the right strategy for managing the DIFM count is crucial. Part of the strategy would entail focusing on those items in the DIFM that are driving aircraft readiness (high NMCS and PMCS cycle times). Another aspect of the strategy would also include repairing components with the Shortest Processing Time [SPT] vice the current traditional method of processing components on a First-In-First-Out [FIFO] basis by requisition priority.

A condition of poor allowance and inventory management is degraded aircraft readiness or A_o, evidenced by a low NMCS/PMCS supply effectiveness rate. This degraded readiness can be identified by accrued aircraft downtime due to lack of parts on the shelf (non-mission capable for supply or NMCS) and subsequently aircraft downtime due to I-level maintenance repair actions (non-mission capable for maintenance or NMCM). The MALS utilizes AV-3M (Naval Aviation Maintenance and Material Management) reporting to track the amount of aircraft downtime due to supply or maintenance factors (NMCS or NMCM). The Naval Air Systems Command maintains a repository of AV-3M information on the internet, in database format, that can be used to analyze NMCS data, NMCM data, and other reliability, maintainability, and supportability trends.

DIFM management and the corresponding metric "DIFM count" can be applied throughout the MALS-14 future reality tree for "parts from the IMA" process depicted in Figure 5-3.

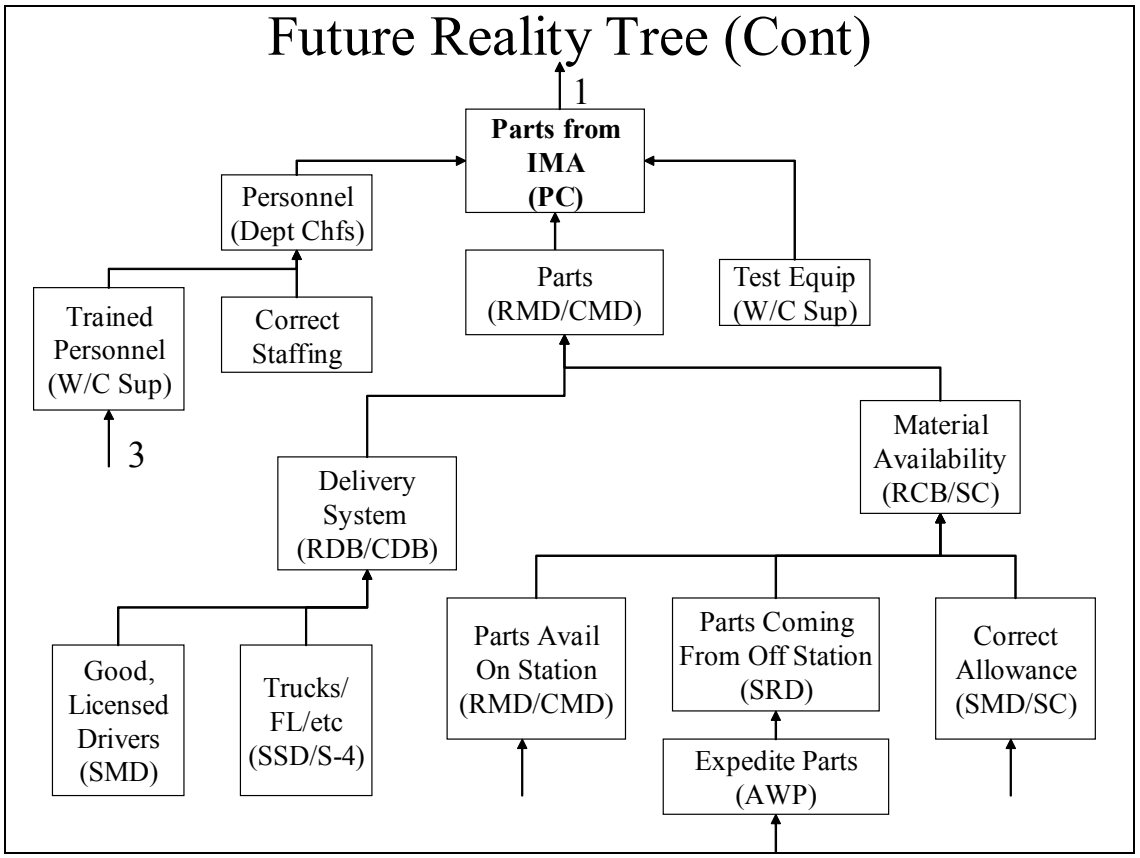


Figure 5- 3 MALS-14 Future Reality Tree (IMA Parts)

As discussed earlier, Material Readiness (Responsiveness and Material Availability) not only applies to the Aviation Supply Department's ability to satisfy readiness degrading requirements "off the shelf" (inventory management), it also applies to the joint efforts of the Aircraft Maintenance and Aviation Supply Department's repair cycle efforts (DIFM management) for replenishing inventory and repairing squadron EXREP requirements. Figure 5-3 displays how Material Readiness (Repair Parts) flows down through the MALS repair cycle.

Parts Produced by the IMA. Equally as important as having spare parts to satisfy a squadron's on-aircraft weapons replaceable assembly (WRA) or consumable requirements is the availability of spare parts (shop replaceable assemblies or SRAs and consumable bit-piece-parts parts) to sustain the MALS intermediate maintenance activity's WRA and SRA repair efforts to replenish deficiencies in the supply officer's inventory and squadrons' expeditious repair (EXREP) requirements for downed aircraft.

As depicted in Figure 5-3, we can further assign ***supply chain response time*** and ***perfect order fulfillment*** metrics for the material readiness aspect of the MALS' production effort: DIFM management. The following is an example where the MALS supply chain can focus on the DIFM count in order to improve aircraft readiness:

Example #1: Per LMDSS, the top MAG-26 NMCS driver (July 01 to July 02) for CH-53E aircraft is the digital computer, NIIN 01-328-0266, WUC 5742100, C3 I-level repair capability, SMR code PAOGK. (Refs. 27 & 28) This part accrued 5,066 hours aircraft downtime for 81% of MAG-26 CH-53E reporting aircraft (total 3,094 flight hours flown). (Ref. 27) Analysis of the MALS-26 DIFM report dated 8/21/2002 revealed 3 digital computers in-work under repair (status M2) for inventory replenishment (Supply Officer assets). No squadron EXREPs (NMCS) were reported in the MALS repair cycle at that snapshot in time.

Further LMDSS research revealed more MALS-26 IMA production information about the digital computer: 35 digital computers were processed at the I-Level (seven components processed BCM, 28 components repaired, ten processed with no defects or A799, Average TAT was seven days, and Average AWP was 8.54 days). The Actual reliability data showed 18 verified failures for a Mean Flight Hour Between Failure of 171.89 hours (out of 3,094 hours flown). Utilizing O-level remove and replace actions (no defects included) as a reference point vice verified failures, the adjusted "realized" MFHBF is 88.4 hours (3,094/35 items replaced at the o-level and inducted into the I-level), which is significantly less from an organizational-level maintenance standpoint. MALS-26 inventory information is as follows: six (6) total assets in inventory; five (5) on the shelf available for issue and one (1) restricted from issue held in war-time reserves (FISP). 2d MAW's FY-2002 Top 25 degrader report for MALS-26 covering the period 10/01/2001 to 03/31/2002 (Ref. 26) showed the digital computer as the 22nd top degrader, with 63% supply effectiveness (16 demands, 10 issues, 6 EXREPs). Of the 6 EXREPs during this timeframe, 5 were repaired, and 1 beyond the capability of I-Level repair. LMDSS data for this timeframe revealed the digital computer as MAL-26's top NMCS degrader for MAG-26 CH-53E aircraft: 1,593 NMCS hours accrued based on 1,594 flight hours flown for 83% of reporting aircraft. (Ref. 27)

Example #1 Summary: it appears there is a repair parts constraint (possibly SRA and bit-piece-part material availability problems) with the digital computer that is preventing them from ensuring there are enough digital computers on the shelf to match demand, when they are needed. Although 63% of digital computers were issued during the first half of FY-02, it was still the top NMCS driver for MAG-26's CH-53E aircraft during that timeframe accruing roughly one hour aircraft downtime for every flight hour flown. For the most part, MALS-26 repairs the defective computers, and in 10 instances, there were actually no defects found at the I-level. The MALS should focus on reducing the amount of NMCS time accrued for this item by ensuring digital computers are always on the shelf, and placing supply officer assets in DIFM as a top priority for repair. As of the 8/21/2002 MALS-26 DIFM report, work center 620's (responsible for repairing the digital computer) DIFM count was 119. The three (3) digital computer supply officer's assets in DIFM represented merely 2.5% of their total DIFM count. Work center 620 must not lose focus of digital computers (historically MAG-26's and the fleet-wide #1 NMCS driver) regardless of the number of other assets in their DIFM (except for EXREPs which always have top priority).

Supply Chain Response Time and Responsiveness Metrics for Parts Produced by the IMA. ***Responsiveness*** is also crucial to the MALS repair cycle effort. The Aviation Supply Department must also be responsive in satisfying the Intermediate Maintenance Activity's spare parts requirements to repair components in DIFM (work in process inventory). The same principles and standards apply to these requirements, as previously discussed with respect to satisfying NMCS/PMCS requirements from supported Marine squadrons. Heightened responsiveness to the IMA's spare parts requirements will eventually lead to a reduced DIFM count, higher NMCS/PMCS supply effectiveness, increased inventory depth, and ultimately higher aircraft readiness.

Perfect Order Fulfillment and Material Availability Metrics for Parts Produced by the IMA. These metrics also apply to the MALS repair cycle effort. Allowance and inventory management must be focused towards providing the IMA the right part, at the right place, at the right time. The Repairables and Consumables

Management Divisions are the key members of the MALS supply chain that influence the allowance inventory management of the IMA's spare parts requirements. The same metrics applied for NMCS/PMCS requirements from the Marine squadrons can be applied to MALS IMA repair cycle efforts. Specifically, those SRA and consumable requirements critical for enabling repair of readiness degraders must be the focus of RMD and CMD. We recommend the MALS utilize an adjusted version of the NMCS/PMCS supply effectiveness metric in order to analyze the Aviation Supply Department's effectiveness in satisfying the IMA's repair requirements. This new metric should analyze, at a minimum, those requisitions that utilize the project code "ZC8" which corresponds to the IMA's material requirements for repairing components in DIFM (non-engine [ZQ9] and non-test bench related [ZF7]). Utilizing this "ZC8 Supply Effectiveness" metric should identify those spare parts (SRAs and consumables) that are preventing the IMA from repairing squadron EXREP requirements as well as those WRA and SRAs in DIFM ultimately bound to replenish the supply officer's inventory and prevent future stock out conditions. Applying the DIFM management principles and DIFM count metric discussed earlier to SRAs in the MALS repair cycle will ultimately increase aircraft readiness by reducing the cycle time associated with WRAs in the DIFM work in process inventory and putting them back in the MALS inventory to satisfy future NMCS/PMCS demands. Data collected from MALS-26 (July, 2001 to July, 2002) displays how the ZC8 supply effectiveness metric can vary significantly from the traditional supply effectiveness metric (Table 5-6). One particular note is that the ZC8 project code not only includes those SRA and consumable requirements directly required for NMCS/PMCS EXREP repairs, but also those SRA and consumable requirements for other DIFM repairs. It would be extremely difficult to segregate those ZC8 project coded requisitions directly related to NMCS/PMCS EXREP repairs, and directly tied to aircraft readiness. The metric as it stands, is a good metric for identifying parts constraints to DIFM management.

Repairables	**Average**	**Goal**
Net Supply Effectiveness	80.11%	85.00%
ZC8 Net Effectiveness	64.94%	85.00%
Gross Supply Effectiveness	76.16%	75.00%
ZC8 Gross Effectiveness	64.74%	75.00%
Consumables	**Average**	**Goal**
Net Supply Effectiveness	87.81%	85.00%
ZC8 Net Effectiveness	64.90%	85.00%
Gross Supply Effectiveness	78.13%	75.00%
ZC8 Gross Effectiveness	62.68%	75.00%

Table 5- 8 MALS-26 ZC8 Supply Effectiveness Comparison

The 2nd Marine Aircraft Wing Aviation Logistics Department currently utilizes a ZC8 project code requisition supply effectiveness metric. Table 5-9 is the MALS-26 ZC8/ZQ9 supply effectiveness summary for the period covering the first half of fiscal year 2002 (10/01/2001 to 03/31/2002). The report displays those parts ordered with the ZC8 and ZQ9 (engine requirements) project codes that have the lowest supply effectiveness per type-model-series-aircraft and type-engine. Also included in the report is basic inventory management information, which can help the aviation logistician determine root causes to DIFM management awaiting parts problems that are driving aircraft readiness. This report also provides details for low ZC8 supply effectiveness rates. For viewing purposes, the ZQ9 project coded requirements were hidden in the Excel spreadsheet, as well as some amplifying inventory management data.

Period 1 Oct 01 - 31 Dec 01

MALS 26 Top 25 ZC8/ZQ9 Degrader Report FY 2002

UIC	TMS	NIIN	RPR WC	COG	DMD FREQ	NIS/NC	SUP EFF	EXREP RFI	BCM	RPR CAP	NOMEN	RO	UI	ON HAND	STK DUE	AMD	AMFD	AT	NICP SMR
09167	AH1W	013333149		9N	4	4	0%	0	0		CONNECTOR-SWITCH	0	EA	0	0	0	1.3	8	
09167	AH1W	006126993		9N	4	4	0%	0	0		SWITCH,SUBASSY	0	EA	0	0	0.1	1.3	8	
09167	AH1W	000824643		9G	4	4	0%	0	0		COVER	0	EA	0	0	0	1.3	8	
09167	AH1W	LLQ485141		9P	3	3	0%	0	0		RESISTOR ASSY	0	EA	0	0	0	1	8	
09167	AH1W	013160761		9Z	2	2	0%	0	0		RING,RETAINI	2	EA	2	0	0.4	0.7	2	
09167	CH46E	013888592	05A	7R	6	6	0%	0	6	X1	CIRCUIT CARD ASSEMB	0	EA	0	0	0.2	2	8	PAGDD
09167	CH46E	001829481		9Z	3	3	0%	0	0		SCREW,MACHINE	0	EA	0	0	0	1	8	
09167	CH46E	002312037		9Z	3	3	0%	0	0		BAR,METAL	0	FT	0	0	0	1	8	
09167	CH46E	002879754		9G	3	3	0%	0	0		BUSHING,SLEEVE	3	PG	0	3	0.3	1	2	
09167	CH46E	007269640		9Z	2	2	0%	0	0		O-RING	0	EA	0	0	0	0.7	8	
09167	CH53E	011318725		9G	5	5	0%	0	0		PRISM,LIGHTING	0	EA	0	0	0	1.7	8	
09167	CH53E	010172077		9N	5	5	0%	0	0		TRANSISTOR	0	EA	0	0	0	1.7	8	
09167	CH53E	011487574		9N	4	4	0%	0	0		TRANSISTOR	0	EA	0	0	0	1.3	8	
09167	CH53E	013984389		9W	4	4	0%	0	0		CABLE ASSY	0	EA	0	0	0	1.3	8	
09167	CH53E	002485754		9G	4	4	0%	0	0		RING, WIPER	0	EA	0	0	0	1.3	8	
09167	UH1N	010520312		9Z	4	4	0%	0	0		SEAL,TAIL ROTOR	6	EA	0	6	1.2	1.3	2	
09167	UH1N	012781396		9N	2	2	0%	0	0		RESISTOR,FIXED, WIRE,	0	EA	0	0	0	0.7	8	
09167	UH1N	006032397		9G	2	2	0%	0	0		FASTENER BELT	0	EA	0	0	0	0.7	8	
09167	UH1N	006355878		9G	2	2	0%	0	0		MOTOR,DIRECT	0	EA	0	0	0.1	0.7	8	
09167	UH1N	013291751		9Z	1	1	0%	0	0		LAMP, INCANDESCENT	0	EA	0	0	0	0.3	8	

Table 5- 9 MALS-26 ZC8/ZQ9 Summary Report Spreadsheet (from Ref. 26)

4. Off-Station Material Availability

Metrics: Responsiveness or Supply Chain Response Time, NMCS/PMCS count, and AWP count. Off-station material availability is the third element of material readiness. Off-station availability is also included in the material readiness aspect of DIFM management (parts from the IMA). When the Aviation Supply Department cannot immediately fulfill a squadron's requirement from on-station inventory, the requirement (after extensive research and screening) is passed "off-station" to the upstream members of the Naval/Marine Corps aviation logistics supply chain. The MALS Supply Response Division, Repairables Management Division, and Consumables Management Division are all critical players in reducing the amount of NMCS/PMCS readiness degrading requisitions referred "off-station." As shown in MALS-14's Future Reality Tree (Figure 5-1), the Aviation Supply Department sought to reduce off-station requirements through proper allowances and on-station material availability. This triad of aviation logistics

processes, coupled with personnel and equipment readiness, ultimately is the key to improving aircraft readiness. When proper allowancing and on-station material availability cannot satisfy a squadron's or the IMA's repair parts requirements, the Supply Response Division and the Repairables Management Division expedite the requirements. The goal is to reduce the overall customer wait time by expediting delivery of the requirement from the upstream members of the Naval/Marine Corps aviation logistics supply chain. For off-station material availability, average customer wait time provides the aviation logistician a starting point for analyzing trends in decreased aircraft readiness. The MALS must focus on those parts that are continually long lead time readiness degraders, and communicate with the proper inventory control point to engage in efforts to reduce procurement cycle times.

NMCS/PMCS and AWP counts are traditional metrics the MALS Aviation Supply Department uses to monitor the amount of off-station requirements any point in time. Increasing NMCS/PMCS counts usually corresponds with a trend in increased aircraft NMC and PMC rates while an increasing AWP count usually corresponds with a trend in increased components in DIFM awaiting parts. Both conditions directly drive NMCS/PMCS cycle time and aircraft readiness. With this in mind, reducing the NMCS/PMCS count and AWP count will result in decreased NMC and PMC aircraft, and components awaiting parts in the IMA. 2d MAW ALD utilizes a daily high priority requisition report to track the number of outstanding NMCS/PMCS requisitions segregated by age (Table 5-10).

Integral to reducing the overall NMCS/PMCS and AWP count is reliable information systems, and personnel readiness. The Naval/Marine Corps aviation logistics supply chain is saturated with a myriad of web-based logistics information systems that provide asset availability, requisition status, and technical information. Mastering the many different logistics information systems will increase the opportunity of reducing the amount of requisitions with long lead times. Skilled expediters can drastically reduce not only the amount of off-station NMCS/PMCS and AWP requisitions, but also the number of invalid requirements. Reconciliation is a hallmark of good expediting, and must be

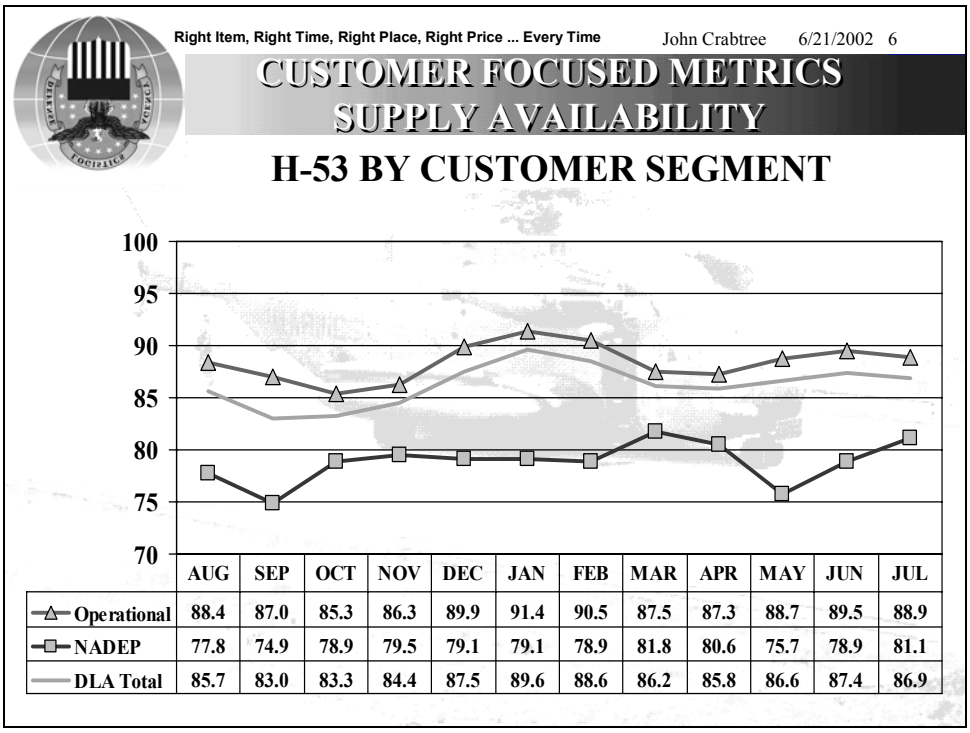
frequently accomplished to ensure the ***right*** parts and requisitions are getting the attention they deserve. Expediting invalid requisitions results in opportunity costs of lost time and funding. With limited time, personnel, and resources (funding), requisition validity is critical to aircraft readiness.

2D MAW CRITICAL SUPPLY REPORT																		
NMCS/PMC/SDLM (AK0/AK7/730) AIRCRAFT RQNS																		
Date Created: 08/05/2002				Days Old														
MAG/	1-10			11-20			12-30			>30			Totals			Up/Down		
Extended TMS	AK0	AK7	730	AK0	AK7	730	AK0	AK7	730	AK0	AK7	730	AK0	AK7	730	AK0	AK7	730
MAG-14	Report Date:		2217													2214		
AV8B	17	1	0	3	0	0	3	0	0	21	2	0	44	3	0	▲3	0	0
AV8B II+	3	0	0	5	1	0	2	0	0	13	2	0	23	3	0	▼2	▼1	0
AV8BR	11	1	0	6	0	0	6	0	0	6	5	0	29	6	0	▼3	▲1	0
EA6B	3	3	0	2	1	0	1	0	0	0	5	0	6	9	0	▼1	▼2	0
KC130F	2	3	0	0	0	0	0	1	0	0	0	0	2	4	0	0	▼1	0
KC130R	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	▲2	0	0
TAV8B	5	1	0	1	0	0	4	0	0	7	0	0	17	1	0	▼4	▲1	0
UAV	2	0	0	0	1	0	0	1	0	0	1	0	2	3	0	▲1	0	0
MAG Totals	45	9	0	17	3	0	16	2	0	47	15	0	125	29	0	▼4	▼2	0
MAG-26	Report Date:		2217													2214		
AH1W	5	0	0	3	0	0	0	0	0	0	0	0	8	0	0	▼1	▼2	0
CH46E	8	6	0	5	2	0	0	0	0	0	0	0	13	8	0	▼3	▲1	0
CH53E	7	5	0	1	2	0	0	0	0	0	1	0	8	8	0	▲3	0	0
UH1N	0	2	0	0	0	0	2	0	0	1	0	0	3	2	0	▼5	0	0
MAG Totals	20	13	0	9	4	0	2	0	0	1	1	0	32	18	0	▼6	▼1	0
MAG-29	Report Date:		2217													2214		
AH1W	5	1	0	0	0	0	1	0	0	0	1	0	6	2	0	▲2	▼1	0
CH46E	7	0	0	2	1	0	0	0	0	0	0	0	9	1	0	▲2	0	0
CH53E	12	1	0	3	0	0	1	0	0	1	3	0	17	4	0	▲5	0	0
UH1N	1	1	0	0	0	0	0	0	0	3	0	0	4	1	0	0	0	0
MAG Totals	25	3	0	5	1	0	2	0	0	4	4	0	36	8	0	▲9	▼1	0
MAG-31	Report Date:		2217													2214		
F/A18A	13	14	0	3	1	0	2	0	0	6	0	2	24	15	2	0	▼3	0
F/A18C	12	3	0	11	6	0	2	1	0	5	1	0	30	11	0	▼2	▲1	0
F/A18D	14	14	0	6	3	0	6	3	0	7	3	1	33	23	1	▼1	▲1	0
MAG Totals	39	31	0	20	10	0	10	4	0	18	4	3	87	49	3	▼3	▼1	0
Totals	129	56	0	51	18	0	30	6	0	70	24	3	280	104	3	▼4	▼5	0

Table 5- 10 2d MAW Daily High Priority Report (from Ref. 26)

Reducing administrative and procurement lead times (ALT and PLT) for aircraft readiness degrading requirements for an individual squadron or MALS ***must*** also be the goal of the upstream members of the aviation supply chain. Current performance metrics of the upstream members of the supply chain track the readiness levels of aircraft in aggregate, and not by individual squadrons (e.g., all AV-8B aircraft, not individual MALS or squadron). As a result, situations could arise where readiness for a certain type

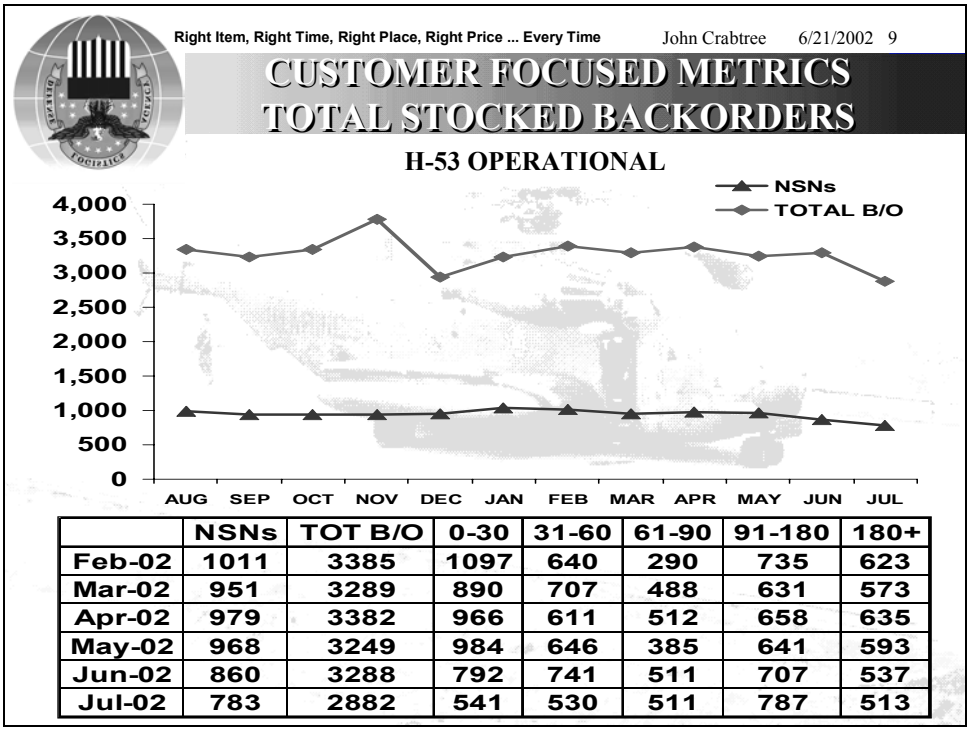
aircraft is satisfactory, yet readiness for an individual Marine squadron is less than satisfactory. In this case, the upstream member's performance metrics must be able to indicate this degraded readiness condition, and allow the inventory control point to act accordingly to provide the necessary resources to eliminate parts constraints or expedite procurement. Figure 5-4 displays how Defense Supply Center Richmond, Virginia (DSCR), the lead center for DoD aviation, measures DLA's material availability (all DLA inventory control points) with respect to how well they are supporting the Navy/Marine Corps H-53 community. Specifically, Figure 5-4 represents the aggregate fill rate percentage of Defense Supply Centers Richmond (Virginia), Columbus (Ohio), and Philadelphia (Pennsylvania) based on demand from the Navy/Marine Corps H-53 community. In the figure, the term "operational units" refers to a ship, air station, or MALS (e.g., USS Tarawa, NASJRB Willow Grove, or MALS-16), and not an individual Marine squadron (e.g., HMH-465).



	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
Operational	88.4	87.0	85.3	86.3	89.9	91.4	90.5	87.5	87.3	88.7	89.5	88.9
NADEP	77.8	74.9	78.9	79.5	79.1	79.1	78.9	81.8	80.6	75.7	78.9	81.1
DLA Total	85.7	83.0	83.3	84.4	87.5	89.6	88.6	86.2	85.8	86.6	87.4	86.9

Figure 5- 4 Defense Supply Center Richmond H-53 Supply Availability Metric (from Ref. 29)

Figure 5-5 displays another metric used by DSCR that provides the total stocked material backorders for Navy/Marine Corps H-53 operational units, for all DLA inventory control points in aggregate. The total backorders are separated by age (0-30 days, 31-60 days, etc.). The term "NSNs" represents the individual line items of stock (National Stock Number) specific to the Navy/Marine Corps H-53 community. This metric gives depth to the material availability metric by providing stock out trends. Although this metric provides a decent indicator of stock out trends for the entire Navy/Marine Corps H-53 operational community, it fails to correlate with the readiness level of the individual Marine squadron.



	NSNs	TOT B/O	0-30	31-60	61-90	91-180	180+
Feb-02	1011	3385	1097	640	290	735	623
Mar-02	951	3289	890	707	488	631	573
Apr-02	979	3382	966	611	512	658	635
May-02	968	3249	984	646	385	641	593
Jun-02	860	3288	792	741	511	707	537
Jul-02	783	2882	541	530	511	787	513

Figure 5- 5 Defense Supply Center Richmond H-53 Backorder Metric

(from Ref. 29)

5. Other Factors

As noted in the MALS-14 Future Reality Tree (Figures 5-1 and 5-3), Material Readiness cannot solely account for the successful performance of the MALS in achieving improved aircraft readiness with the MAG. Personnel and equipment resource metrics must also be focused on to achieve a total supply chain management success. If

material readiness is optimized (responsive and available parts) without the proper personnel and equipment resources within the MALS, the MALS will almost surely fail in any effort to achieve their strategic logistics management plan goal of improved aircraft readiness. Appropriate metrics must also be developed to assure optimal personnel and equipment resource levels within the MALS to support corresponding material readiness metrics.

E. A "SCM" ORIENTED REPORTING SYSTEM

The performance metrics of **perfect order fulfillment** and **supply chain response time** must be integrated throughout not only the MALS, but also throughout the entire Naval/Marine Corps aviation logistics supply chain. Utilizing these two performance metrics throughout the entire enterprise will focus ***all members*** of the supply chain on the common goal of aircraft readiness. Without supply chain-focused performance metrics, the MALS will only be able to influence marginal improvements in aircraft readiness. We recommend utilizing a web-based reporting system similar to the one used by MALS-14. The only shortfall to MALS-14's reporting system is that it restricted itself to the processes and performance metrics solely within the MALS. Upstream members of the supply chain are not integrated within this reporting system. The "cockpit charts" and web-based Planeside Assessment Tool (web-PAT) used by the NAVRIT and CFT-2 members provide a better example of a reporting system that integrates the performance of upstream members of the aviation supply chain towards improving aircraft readiness. Unfortunately, this reporting system does not integrate ***all*** members of the supply chain (e.g., DLA ICPs, Distribution Depots, etc) which can influence customer wait times and material availability and subsequently, aircraft readiness.

Leveraging the Planeside Tool

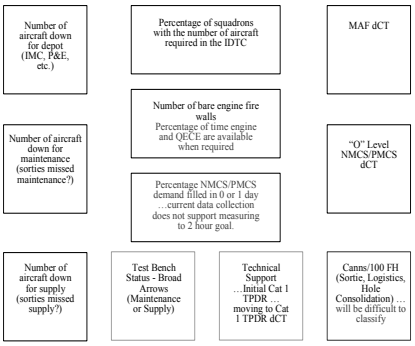
NAVAL AIR FORCE

Planeside ILS Tool Summary

Planeside Performance Summary — V1 19SEP2001

Planeside Performance (NMCS/PMCS)	GOAL	LEMOORE	NI	WHIDBEY	PT MUGU			
Percentage First Day Issue	75%	61.8	48.3	73.8	41.9	75%OR ABOVE	> 70% & < 75%	70% AND BELOW
Average Customer Wait Time (ACWT)	4 D	13.2	9.4	7.1	18.5	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Consumable ACWT	4 D	14.8	10.4	10.9	22.6	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Repairable ACWT	4 D	12.1	8.5	6.1	16.1	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Sustainability								
PEB/RIMS fills as a % of total consumable RQNS	25%	39.0%	26.0%	59.0%	30.0%	25% OR LESS	< 25% & >20%	20% OR LESS
Wholesale Stock Replenishment Time	23 D	19	39	23	31	23 DAYS OR LESS	> 23 & < 29 DAYS	29 OR > DAYS
Unfilled Initial Issues	N/A	202	217	282	231			
Production								
WRA TAT	6.9 D	11.4	12.3	7.6	18.4	7 DAYS OR <	> 7 & < 11 DAYS	11 OR > DAYS
Bare Firewalls	0	4	15	2	2	0	1 TO 5	5 OR MORE
Repair Rate (All BCM)	N/A	61.1%	64.1%	70.4%	65.0%			
Repair Rate (Less BCM-1)	80%	78.4%	79.1%	85.2%	79.7%	80%OR ABOVE	> 75% & < 80%	75% AND BELOW
Production Resources (non-engine)								
Percentage First Day Issue AWP	75%	66.8	35.6	44.6	38.9	75%OR ABOVE	> 70% & < 75%	70% AND BELOW
ACWT AWP	4 D	8.1	14.1	9.7	11.6	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Consumable ACWT AWP	4 D	4.8	13.7	8.8	11.3	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Repairable ACWT AWP	4 D	14.9	15.2	12.3	12.3	4 DAYS OR LESS	> 4 & < 7 DAYS	7 OR > DAYS
Manning Posture								
CORE Rating COB as a percentage of BA	100%	68%	78%	81%	118%	90%OR ABOVE	> 80% & < 90%	80% AND BELOW
CORE Rating DNEC/MOS as a percent of BA	100%	73%	85%	88%	114%	90%OR ABOVE	> 80% & < 90%	80% AND BELOW
ASD Manning (Civilian/Military)	100%	94%	80%	85%	83%	90%OR ABOVE	> 80% & < 90%	80% AND BELOW
Aircraft, Engine and Support Equipment Inventory								
PAI as a percent of PAA	100%	86%	87%	76%	90%	90%OR ABOVE	> 80% & < 90%	80% AND BELOW
Bare Firewalls	0	4	15	2	2	AT GOAL	1-5	>5
Broad Arrows	N/A	16	7	21	9			
Active CAT I TPDRs for TMS Supported	0	12	53	33	25	0	N/A	1 AND ABOVE
Issued/Unincorporated IRACs	N/A	33	129	51	67			

CFT 2 Cockpit Chart


Number of aircraft down for depot (IMC, P&E, etc.)
Percentage of squadrons with the number of aircraft required in the IDTC
MAF dCT
Number of bare engine fire walls
Percentage of time engine and QECE are available when required
Number of aircraft down for maintenance (sorties missed maintenance?)
"O" Level NMCS/PMCS dCT
Percentage NMCS/PMCS demand filled in 0 or 1 day …current data collection does not support measuring to 2 hour goal.
Number of aircraft down for supply (sorties missed supply?)
Test Bench Status - Broad Arrows (Maintenance or Supply)
Technical Support …Initial Cat 1 TPDR … moving to Cat 1 TPDR dCT
Canns/100 FH (Sortie, Logistics, Hole Consolidation) … will be difficult to classify

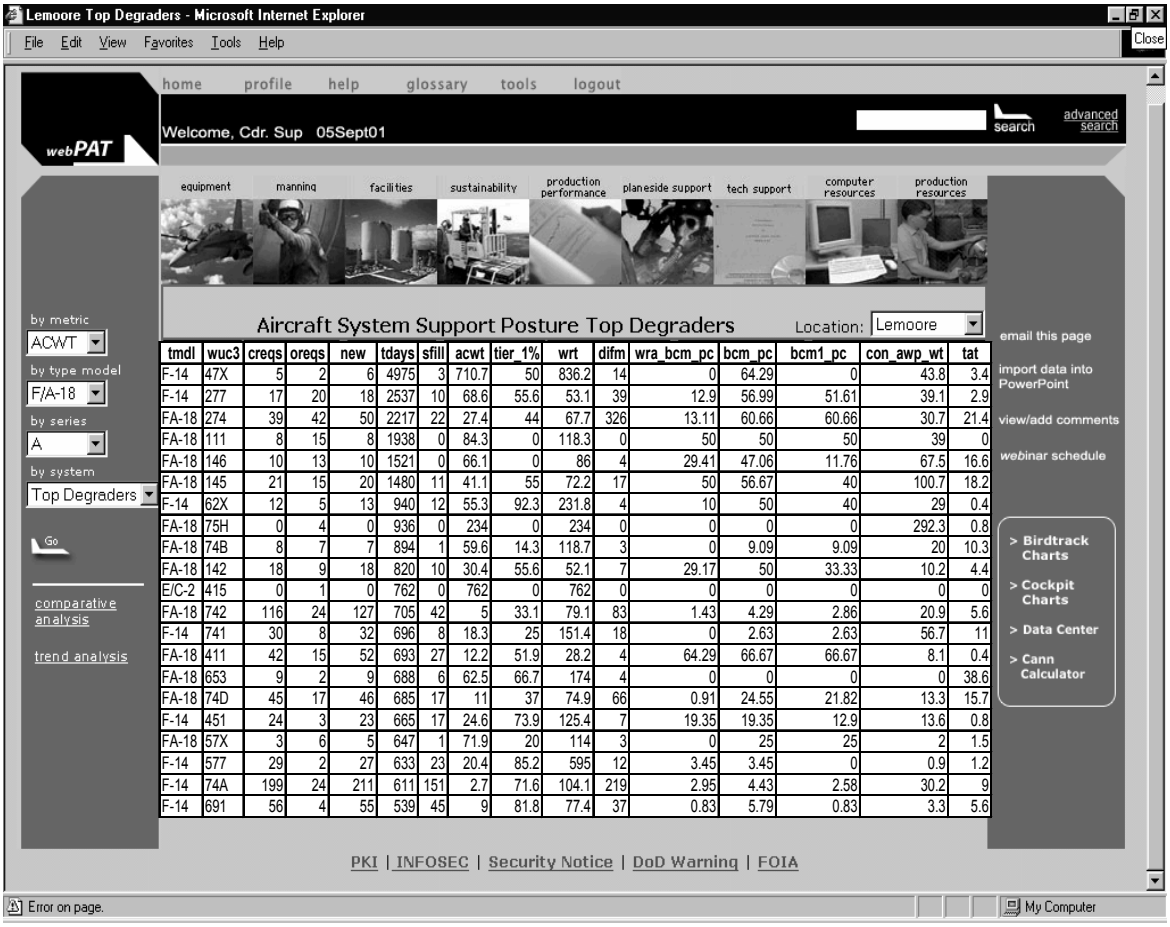
- Tool "feeds" cockpit chart
- And documents "actionable" degraders at squadron level

- Cockpit chart reveals readiness at fleet level
- And helps to further validate planeside tool

23

Figure 5- 6 NAVRIT Planeside ILS Tool Summary and Cockpit Chart Graphic

(from Ref. 30)



tmdl	wuc3	creqs	oreqs	new	tdays	sfill	acwt	tier_1%	wrt	difm	wra_bcm_pc	bcm_pc	bcm1_pc	con_awp_wt	tat
F-14	47X	5	2	6	4975	3	710.7	50	836.2	14	0	64.29	0	43.8	3.4
F-14	277	17	20	18	2537	10	68.6	55.6	53.1	39	12.9	56.99	51.61	39.1	2.9
FA-18	274	39	42	50	2217	22	27.4	44	67.7	326	13.11	60.66	60.66	30.7	21.4
FA-18	111	8	15	8	1938	0	84.3	0	118.3	0	50	50	50	39	0
FA-18	146	10	13	10	1521	0	66.1	0	86	4	29.41	47.06	11.76	67.5	16.6
FA-18	145	21	15	20	1480	11	41.1	55	72.2	17	50	56.67	40	100.7	18.2
F-14	62X	12	5	13	940	12	55.3	92.3	231.8	4	10	50	40	29	0.4
FA-18	75H	0	4	0	936	0	234	0	234	0	0	0	0	292.3	0.8
FA-18	74B	8	7	7	894	1	59.6	14.3	118.7	3	0	9.09	9.09	20	10.3
FA-18	142	18	9	18	820	10	30.4	55.6	52.1	7	29.17	50	33.33	10.2	4.4
E/C-2	415	0	1	0	762	0	762	0	762	0	0	0	0	0	0
FA-18	742	116	24	127	705	42	5	33.1	79.1	83	1.43	4.29	2.86	20.9	5.6
F-14	741	30	8	32	696	8	18.3	25	151.4	18	0	2.63	2.63	56.7	11
FA-18	411	42	15	52	693	27	12.2	51.9	28.2	4	64.29	66.67	66.67	8.1	0.4
FA-18	653	9	2	9	688	6	62.5	66.7	174	4	0	0	0	0	38.6
FA-18	74D	45	17	46	685	17	11	37	74.9	66	0.91	24.55	21.82	13.3	15.7
F-14	451	24	3	23	665	17	24.6	73.9	125.4	7	19.35	19.35	12.9	13.6	0.8
FA-18	57X	3	6	5	647	1	71.9	20	114	3	0	25	25	2	1.5
F-14	577	29	2	27	633	23	20.4	85.2	595	12	3.45	3.45	0	0.9	1.2
F-14	74A	199	24	211	611	151	2.7	71.6	104.1	219	2.95	4.43	2.58	30.2	9
F-14	691	56	4	55	539	45	9	81.8	77.4	37	0.83	5.79	0.83	3.3	5.6

Figure 5- 7 Web-based Planeside Assessment Tool (from Ref. 30)

F. SUMMARY

Measuring aviation logistics responsiveness (supply chain response time) and material availability (perfect order fulfillment), coupled with personnel and equipment readiness, are the two most important aviation logistics metrics for improving aircraft readiness. These metrics should not only be used by the MALS, but also integrated with ***ALL*** upstream members of the Naval/Marine Corps aviation logistics supply chain. Without total supply chain integration, the MALS can only hope for marginal improvements in aircraft readiness. Even more important, metrics alone cannot help a MALS improve aircraft readiness without a strategic logistics management plan, as proven by MALS-14 success.

VI. CONCLUSIONS AND RECOMMENDATIONS

The scope of this thesis was developing performance metrics that link supply chain management to aircraft readiness. Inherent in this effort was evaluating and analyzing current strategic logistics management planning methods grounded in the overarching principles of supply chain management. This further required mapping and defining the entire Naval/Marine Corps aviation logistics supply chain. Our primary focus was solely on the tactical segment of the Naval/Marine Corps aviation logistics supply chain: the Marine Aviation Logistics Squadron. Only by first understanding the interdependent relationships of all the members of the Naval/Marine Corps aviation logistics supply chain could we begin to understand developing performance metrics that link supply chain management to aircraft readiness at tactical level of aviation logistics.

To supplement our firm understanding of strategic logistics management planning grounded in the principles of supply chain management, we analyzed the tenets of the Theory of Constraints management method and its applicability to Marine Corps aviation logistics. Building on this knowledge we conducted a case study analysis of the implementation of a structured planning and feedback system coupled with the Theory of Constraints method to improve aircraft readiness in Marine Aircraft Group 14, Marine Corps Air Station Cherry Point, North Carolina. The specific unit analyzed, Marine Aviation Logistics Squadron 14, successfully implemented a strategic logistics management plan, optimized aviation logistics operations, and achieved increased aircraft readiness within MAG-14. As a result, MALS-14 was the second MALS utilizing strategic logistics management planning and the Theory of Constraints to improve aircraft readiness, and subsequently won official recognition as the Marine Aviation Logistics Squadron of the Year for 2001 by Headquarters, Marine Corps and the Marine Corps Aviation Association (MALS-12 won the MALS of the year award in 1999 utilizing the Theory of Constraints).

Drawing lessons learned during the MALS-14 case study analysis, we developed performance metrics that the MALS can implement to tie supply chain management to

aircraft readiness. The metrics, Supply Chain Response Time and Perfect Order Fulfillment, can be implemented not only at the MALS level (the focus of our thesis), but also integrated with and applied by the upstream members of the Naval/Marine Corps aviation logistics supply chain. Our research indicated that by employing strategic logistics planning and focusing on these supply chain oriented metrics at the MALS, aviation logisticians can identify primary aircraft readiness degraders, and take the appropriate steps to eliminate them. Our research also indicated that by using these metrics, the MALS can identify the level of aircraft readiness "owned" by the upstream members of the Naval/Marine Corps aviation logistics supply chain. From a supply chain management perspective, we realized the MALS "owns" only a small share of degraded aircraft readiness.

A. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusion #1: The Logistics Management Institute's Six Step Process for Implementing Supply Chain Management in the Department of Defense and Adapted SCOR Model Provides a Basis for Strategic Logistics Management Planning, and is Relevant and Applicable to Naval/Marine Corps Aviation Logistics and the MALS.

We developed a basic foundation of understanding the Naval/Marine Corps' aviation logistics infrastructure from a supply chain management perspective, based on the Logistics Management Institute's *DoD Supply Chain Management Implementation Guide*. A precipitate of this analysis was designing a high-level graphical model mapping and defining the complex interdependencies of the Naval/Marine Corps aviation logistics supply chain network and a detailed process flow diagram describing the tactical aviation logistics operations of the Marine Aviation Logistics Squadron (MALS). These two graphics can help provide Marine aviation logisticians a visual reference for developing **supply chain-oriented performance metrics for the MALS** that can integrate with upstream aviation logistics supply chain activities. Utilizing *The Guide*, we adapted a strategic logistics management plan for improving aircraft readiness and

Marine aviation logistics at the tactical level, and provided the structural framework for developing readiness-based performance measures. Although *The Guide's* impetus was to provide a plan to implement SCM throughout the end-to-end logistics and supply enterprise of an organization, our focus was on the Marine Aviation Logistics Squadron. Developing a specific strategic logistics plan for implementing supply chain management and performance metrics for the Naval/Marine Corps aviation logistics supply chain enterprise is outside the scope of this thesis, and a much larger and complex undertaking. Most of the fundamentals discussed in **The Six Step Process for Implementing SCM** is relevant and can be applied within the Marine Aircraft Group and Marine Aviation Logistics Squadron in order to develop SCM-oriented, readiness-based performance metrics that will 1) improve current and future aviation logistics support and aircraft readiness where required, 2) help prepare the MALS for the eventual implementation of SCM within Naval/Marine aviation logistics, and 3) once SCM is implemented, serve as the overarching logistics strategy to integrate all Naval/Marine Corps aviation logistics supply chain activities' performance metrics towards a common goal: aircraft readiness or operational availability (A_o).

2. Recommendation #1: Implement Supply Chain Management within Naval/Marine Corps Aviation Logistics and Require Strategic Logistics Management Planning at the MALS.

In order to integrate the performance and metrics of all members of the Naval/Marine Corps aviation logistics supply chain towards the common goal of achieving optimized aircraft readiness, the Department of the Navy and the Marine Corps should implement supply chain management as recommended in *The Guide.* These same principles of supply chain management should also be implemented at the MALS. In order to implement supply chain management principles, we recommend that the leadership of Marine Corps aviation require all MALS Commanding Officers submit Strategic Logistics Management Plans to their immediate (Marine Aircraft Group Commander) and next higher headquarters (Marine Aircraft Wing Commanding Generals) within 45 days after assuming command delineating how their organization

will improve and sustain aircraft readiness and aviation logistics support during their tenure. We further recommend that training modules for Strategic Logistics Management Planning and supply chain management be implemented as a part of the curricula taught at entry-level (officer) and career-level (officer and enlisted) aviation logistics Military Occupational Specialty (MOS) schools, and in officer and staff non-commissioned officer professional military education resident and distance learning courses. One possible alternative solution could be to develop a Marine Corps Institute (MCI) distance-learning course for "Marine Aviation Logistics Strategic Management Planning" similar to the Marine Corps Planning Process course (8805). Marine Aircraft Wing Logistics Management Assistance and Training (LOGMAT) and Aviation Supply LOGMAT Teams should also provide the MALS sustainment training in Strategic Logistics Management Planning and supply chain management.

3. Conclusion #2: The Theory of Constraints is a Viable Tool for Defining the Ultimate Goal of Marine Aviation Logistics and Identifying and Eliminating Constraints (Readiness Degraders) that Prevent the MALS from Achieving that Goal.

The Naval/Marine Corps aviation logistics supply chain is a system of interrelated, interdependent organizations and processes that are designed to sustain and support aircraft weapon systems. Therefore, the principles, tools, and methods of the Theory of Constraints can be used to improve supply chain and weapon system performance through the use of Logic Trees and the Five Focusing Steps. Process flow diagrams can be used to identify a bottleneck or constraint within the aviation logistics support process; however, Logic Trees provide the means of identifying the root cause of the constraint (degraded readiness) through cause and effect relationships. Furthermore, we used the Five Focusing Steps to identify and eliminate a constraint within an adapted SCOR Level 3 Delivery Process. In addition, we showed how the Theory of Constraints and the Logic Trees link performance metrics to the global goal of the organization.

4. **Recommendation #2: Supplement Strategic Logistics Management Planning with Theory of Constraints management to help the MALS (and Naval/Marine Corps aviation logistics supply chain) focus on and improve aircraft readiness and aviation logistics.**

We recommend the MALS supplement their Strategic Logistics Management Plan with the principles, tools, and methods of the Theory of Constraints. Utilizing Logic Trees and the Five Focusing Steps of Theory of Constraints management will provide the MALS a means of identifying and eliminating constraints to achieving improved aircraft readiness and aviation logistics support. Theory of Constraints management training should be supplemented within the training proposal outlined in recommendation #1. Numerous commercial consulting firms specializing in the Theory of Constraints management method can provide more detailed training.

5. Conclusion #3: MALS-14's Successful Implementation of a Structured Planning and Feedback System Based on the Theory of Constraints Justifies the Need for a Strategic Logistics Management Plan Rooted in the Fundamentals of Supply Chain Management.

MALS-14 established crystal-clear goals, developed a strategy to achieve the goals, and implemented a reporting system to manage critical success factors. The aim was to integrate critical processes of the squadron toward a common goal. The key was to capitalize on the power of ownership. Every leader was instrumental in the development of his or her strategy to achieve the ultimate goal of the squadron. MALS-14 was able to cut through the complex world of Naval/Marine Corps aviation logistics and focus the effort of its leaders on the processes towards achieving the goal. MALS-14 used sound leadership, strategic thinking, and the Theory of Constraints to develop a strategic plan and feedback system to improve aircraft readiness. In November 2001, MAG-14 achieved 82 percent readiness. Additionally, MALS-14 was selected as the Marine Aviation Logistics Squadron of the Year for 2001.

6. Recommendation #3: Establish MALS-14's Successful Efforts as the Marine Corps Aviation Logistics Benchmark for Implementing Strategic Planning and Theory of Constraints Management in the MALS.

We conclude that MALS-14's structured planning and feedback system was a successful implementation of a Strategic Logistics Management Plan. MALS-14's success should be used as a benchmark for all Marine Aviation Logistics Squadrons to strive towards in developing and implementing their own Strategic Logistics Management Plans.

7. Conclusion #4: Employing Supply Chain-Oriented, Readiness-Based Performance Metrics (Supply Chain Response Time and Perfect Order Fulfillment) Are Critical to Improving Aircraft Readiness.

Measuring aviation logistics responsiveness (supply chain response time) and material availability (perfect order fulfillment), coupled with personnel and equipment readiness, are the two most important aviation logistics metrics for improving aircraft readiness. These metrics should not only be used by the MALS, but also integrated with ***ALL*** upstream members of the Naval/Marine Corps aviation logistics supply chain. Without total supply chain integration, the MALS can only hope for marginal improvements in aircraft readiness since the majority of degraded aircraft readiness is "owned" by upstream members of the supply chain. Even more important, metrics alone cannot help a MALS improve aircraft readiness without a Strategic Logistics Management Plan, as proven by MALS-14's success.

8. Recommendation #4: Implement Supply Chain Response Time and Perfect Order Fulfillment as the Preferred Performance Metrics for the MALS and the Naval/Marine Corps Aviation Logistics Supply Chain.

Supply Chain Response Time and Perfect Order Fulfillment should be implemented at the MALS, and integrated with ALL members of the Naval/Marine Corps aviation logistics supply chain for improving aircraft readiness. Every activity

within the Naval/Marine Corps aviation logistics supply chain should focus priorities of effort and resources on reducing Customer Wait Time/Logistics Response Time and increasing Material Availability for readiness degraders affecting not only all of Naval/Marine Corps aviation, but also readiness degraders impacting an *individual squadron.* We further recommend that the MALS implement the following peculiar performance metrics to help focus on improving aircraft readiness:

a. Inventory Management

- Proper Allowance Management.
- On-station Availability: Implement R-Pool repairables management procedures, NMCS/PMCS/ZC8 Supply Effectiveness, R-Pool Range and Depth, Readiness-Critical Consumables Range and Depth.
- Off-station Availability: NMCS/PMCS/AWP count

b. DIFM Management

- DIFM count for readiness degraders.

c. Responsiveness

- Logistics Response Time: modify current aviation logistics management information systems to track Supply Chain Response Time by each individual activity in the Naval/Marine Corps aviation logistics supply chain. Furthermore, Supply Chain Response Time should be measured for an individual NSN, group of NSNs (weapon system), aircraft, flying squadron, and/or MALS.

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APPENDIX A.

MAPPING THE NAVAL/MARINE CORPS AVIATION LOGISTICS SUPPLY CHAIN

A. OVERVIEW

Steps two and four in the six step process of implementing SCM in DoD logistics involved developing the supply chain implementation strategy and designing the supply chain. One of the key elements in developing a strategic logistics management plan is defining (or re-defining) the future or "to-be" supply chain. Before determining what the future supply chain should look like, we recommended the organization "map" their current supply chain. Mapping the supply chain helps the aviation logistician to better understand and potentially manage and influence improved performance of not only the entire supply chain process, but more importantly, optimize their functional performance as a segment within that architecture based on SCM principles and the six step process.

Step four, "Designing your supply chain," recommended designing a high level operational graphic based on an adapted SCOR model. This model displayed the basic linear aspect of the aviation logistics supply chain from end-to-end. Unfortunately, a unique aspect of the Naval/Marine Corps aviation logistics supply chain organizational structure is that it is a very network oriented, especially depending on the geographic location of the MALS and its supported squadrons. The MALS relies on aviation logistics support from many other members external to the basic linear supply chain depicted in the adapted SCOR model. The upstream supply chain members depicted in the adapted SCOR model in chapter 2 are also organized as complex networks of logistics activities. This appendix provides an alternate high level operational graphic displaying the complex network and physical locations of members external to the basic

linear Naval/Marine Corps aviation logistics supply chain depicted in the adapted SCOR model in chapter 2.

B. HIGH LEVEL OPERATIONAL SUPPLY CHAIN GRAPHIC

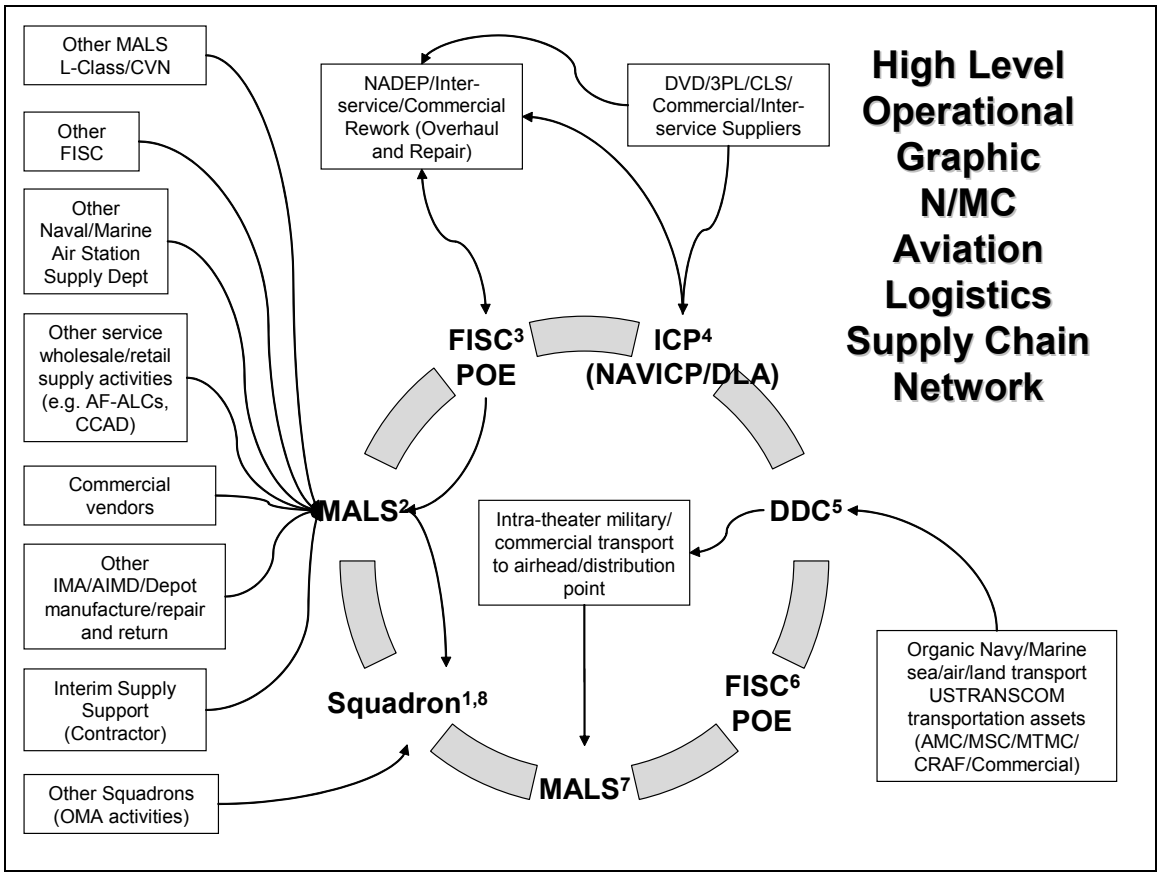

Figure A- 1 Naval/Marine Corps Aviation Logistics Supply Chain Network Diagram

1. The Squadron (Customer)

As shown in Figure A-1, the Naval/Marine Corps aviation logistics supply chain begins with the end-user: the aircraft squadron. Marine aircraft squadrons are located aboard Marine Corps Air Stations throughout the continental United States, as well as overseas in Japan. Marine reserve squadrons are located aboard Marine Corps and Naval Air Stations, an Air Force Base, Joint Reserve Bases, an Air National Guard Base, and in one extreme case, separated from a military installation (HMLA-775

Detachment Alpha located at Cambria County Regional Airport in Johnstown, Pennsylvania). This graphical depiction displays the supply chain relationships between squadrons and their primary supporting activity: the Marine Aviation Logistics Squadron (MALS). There are many scenarios when Marine squadrons are not directly supported by a MALS, adding to the complexity of the Naval/Marine Corps aviation logistics supply chain. Marine helicopter squadrons and rotary-wing and fixed-wing aircraft detachments consolidate and deploy as Aviation Combat Elements of Marine Expeditionary Units (Special Operations Capable) aboard L-class amphibious ships. Marine fixed wing squadrons also deploy with Carrier Air Wings aboard Nuclear Aircraft Carriers (CVNs). In both of these instances, the Marine squadrons do not receive support their primary aviation logistics support from a MALS. The ship's (L-class or CVN) Supply Department and Aircraft Intermediate Maintenance Departments (augmented with MALS aviation supply and aircraft maintenance personnel) provide primary aviation logistics support to the embarked Marine squadron. In recent history, Marine squadrons deployed with Special Purpose Marine Air Ground Task Forces (SPMAGTF) to remote regions of the world participating in Joint Task Force exercises and operations. In some of these scenarios, the squadrons received their primary aviation logistics support from a MALS deployed aboard aviation logistics support ships (T-AVB) [e.g., Somalia operations], ashore in Mobile Facility complexes (e.g., Desert Shield and Storm, Bosnia and Kosovo operations), and from Amphibious Ready Groups (ARGs) operating in the Area of Responsibility (AOR) while the embarked squadron is operating ashore (e.g., Afghanistan operations).

2. The Marine Aviation Logistics Squadron (MALS)

The first link in the Naval/Marine Corps aviation logistics supply chain network for the Marine squadron is the Marine Aviation Logistics Squadron (MALS). All active duty Marine squadrons are directly supported by the MALS in garrison aboard Marine Corps Air Stations. A MALS provides intermediate-level maintenance, aviation supply, and ordnance/armament support for aircraft and aeronautical equipment. (Ref. 2:p 1005) The following is a list of the locations of all the Marine Aviation Logistics Squadrons:

- Marine Corps Air Station Miramar, CA
    - MALS-16 and MALS-11
- Marine Corps Air Facility Camp Pendleton, CA
    - MALS-39
- Marine Corps Air Station Yuma, AZ
    - MALS-13
- Marine Corps Air Station New River, N.C.
    - MALS-26 and MALS-29
- Marine Corps Air Station Cherry Point, N.C.
    - MALS-14
- Marine Corps Air Station Beaufort, S.C.
    - MALS-31
- Marine Corps Air Station Futemna, Japan
    - MALS-36
- Marine Corps Air Station Iwakuni, Japan
    - MALS-12
- Stewart Air National Guard Base, NY
    - MALS-49
- Naval Air Station Joint Reserve Base Atlanta, GA
    - MALS-42
- Naval Air Station Joint Reserve Base Fort Worth, TX
    - MALS-41

The MALS is a deployable unit that can provide aviation logistics support to Marine squadrons in a remote environment. As stated earlier, the MALS deploys and

operates in aviation logistics support ships (T-AVBs), out of Mobile Facility (MF) complexes ashore, in suitable facilities in a remote operating environment, or as a task organized detachment augmenting a Marine squadron or Aviation Combat Element. In certain situations, the MALS is not the activity providing a Marine squadron aviation logistics support in the second link in the Naval/Marine Corps aviation logistics supply chain. Other activities that might be providing the same level of support are the Supply Department and Aircraft Intermediate Maintenance Department of a Naval Air Station, Naval Air Station Joint Reserve Base, L-class amphibious ship, or nuclear aircraft carrier (CVN). Figure A-1 also shows how complex the aviation logistics supply chain can be at the MALS' level by depicting the activities the MALS can receive additional "lateral or horizontal" aviation logistics support from (external to the traditional supply chain process flow).

3. The Fleet and Industrial Supply Center (or Designated Supply Point of Entry)

The MALS receives its primary supply support from a designated supply point of entry (POE). This can be the host Marine Corps or Naval Air Station Supply Department, or the regional Fleet and Industrial Supply Center (FISC). On the east coast, primary supply points of entry for an active duty MALS are the host Marine Corps Air Station supply departments (e.g., MCAS Cherry Point Station Supply Department), which in turn are supported by the appropriate regional FISC (e.g., FISC Norfolk VA). The Navy's FISCs are located in San Diego CA, Norfolk VA, Jacksonville FL, Puget Sound WA, and Yokosuka Japan. Marine Corps and Naval Air Stations inventories are primarily replenished by the FISCs, and FISC inventories are primarily replenished by the Defense Logistics Agency and Naval Aviation Depots (some repair and overhaul work for aviation depot level repairable spare parts is outsourced under contract logistics support). The Naval Aviation Depots (NADEPs) are located at MCAS Cherry Point NC, NAS North Island CA, and NAS Jacksonville FL.

FISC San Diego, California partnered with the Commander, Naval Air Forces Pacific Fleet (CNAP) and Commander, Naval Air Reserve Forces (CNARF) to consolidate inventories with their Naval Air Station Supply Departments' (except

selected "W" purpose retail inventories). The effect resulted in a "virtual inventory consolidation" to support CNAP and CNARF squadrons, including Marine Squadrons supported by CNAP and CNARF air stations. Marine Corps Air Station Supply Departments also participate in this joint venture (e.g., MCAS Miramar and Yuma). As a result, a Marine squadron based at MCAS Miramar ordering a consumable part through MALS-16 (collocated at MCAS Miramar) that is "not carried" or "not in stock" will be passed to FISC San Diego, not MCAS Miramar station supply department. If the part is stocked in MCAS Miramar's inventory, FISC San Diego's inventory management system directs MCAS Miramar station supply department to issue the part (the closest supply supporting activity). If the part is "not carried" or "not in stock" at MCAS Miramar station supply department, the squadron's requisition can be satisfied by any wholesale level inventory maintained by other Marine Corps or Naval Air Station supply departments within the FISC San Diego partnership. Figure A-2 lists activities that are members of the FISC San Diego partnership:

- FISC San Diego CA
- Shore Intermediate Maintenance Activity San Diego CA
- Naval Air Weapons Station China Lake CA
- Marine Corps Air Station Miramar CA
- Naval Aviation Depot North Island CA
- Naval Warfare Assessment Station Corona CA
- Naval Air Station Point Mugu CA
- Marine Corps Air Station Yuma AZ
- Naval Air Station Joint Reserve Base Fort Worth TX
- Naval Air Station Joint Reserve Base New Orleans LA
- Naval Air Station Joint Reserve Base Atlanta GA
- Naval Air Station Joint Reserve Base Willow Grove PA
- Naval Air Facility Washington DC
- Marine Aviation Logistics Squadron 49 Stewart Air National Guard Base NY

Figure A- 2 FISC San Diego CA Sites

4. Inventory Control Points (ICPs)

The fourth link in the Naval/Marine Corps aviation logistics supply chain is the inventory control point. If by this level, the Marine squadron's requisition has not been satisfied by the host Marine Corps or Naval Air Station, or the regional FISC, the requisition is then passed to the inventory control point (ICP) for the material ordered. For most Aviation Depot Level Repairable (AVDLR) [7R_ and 0R_ cognizance material], Field Level Repairable (FLR) [1RD cognizance material], and certain consumable requirements (1RM and 0QM cognizance material) requirements for Marine Corps aircraft, the ICP is the Naval Inventory Control Point-Philadelphia (NAVICP-P). NAVICP-P procures wholesale aviation material from commercial vendors, and stocks the material at the FISCs. NAVICP-P also procures retail aviation material for initial outfitting and replacement inventory allowance requirements for the MALS, NAS, and NASJRB Supply Departments. NAVICP-P also coordinates AVDLR repair and overhaul level scheduling with the NADEPs and contracted commercial repair activities to replenish wholesale and retail AVDLR inventories. Consumable and certain FLR requirements (9_ and 3_D cognizance material) are managed by the Defense Logistics Agency (DLA) network of ICPs, depending on the commodity of material requested. At present, there are three primary DLA ICPs that provide supply support to Marine Corps and Naval Air Stations and FISCs; Defense Supply Center Richmond VA (9G and 3GD cognizance material), Defense Supply Center Columbus OH (9C, 9N, 3CD, and 3ND cognizance material), Defense Supply Center Philadelphia PA (9Z, 3ZD and 9D cognizance material). The Air Force Material Command (Dayton OH) provides supply support and depot-level maintenance support (USAF Air Logistics Centers at Ogden UT, Warner Robins GA) for Marine aircraft (KC-130_ variants) in coordination with NAVICP-P. NAVICP-P and the Naval Air Systems Command also coordinate with the Air Force Material Command aircraft preservation and demilitarization/disposal at the Aerospace Maintenance and Regeneration Center (AMARC) located at Davis Monthan Air Force Base, AZ. In fact, it is not too uncommon for fleet aviation units to request (from NAVICP-P) cannibalization of parts off aircraft stricken from the naval inventory marked for disposal to satisfy urgent aircraft readiness degrading requirements. The

Army Material Command's Aviation and Missile Command (Redstone Arsenal AL) provides supply and depot-level maintenance support (Corpus Christi Army Depot) for Marine aircraft (AH-1W and UH-1N) in coordination with NAVICP-P.

Current initiatives by both DLA and NAVICP-P include coordinating with commercial activities to provide direct vendor delivery, 3rd party logistics, and contract logistics support to improve reliability of weapons systems and decrease logistics response time for Navy and Marine Corps aviation customers. The following is a quick synopsis of these initiatives:

- Direct Vendor Delivery (DVD): "The benefits of Direct Vendor Delivery (DVD) come from reducing the logistics response time (LRT) by shipping directly from the vendor to the user. In the case where a DVD contract includes repairable support, effectiveness increases by combining the procurement and repair pipelines. Long-term DVD contracts ideally reduce the Navy's investment in spare parts inventory. The goal is to manage suppliers, not parts. However, when a DVD is put in place with initial system acquisition, government investment in spare parts may be deferred or eliminated entirely." (Ref. 31) DVD acquisition advice coded material requisitioned by the Marine squadron flows through the ICP, and is referred directly to the vendor for delivery to the Marine squadron.

- Contractor Logistics Support (CLS): "In Contactor Logistics Support (CLS), the contractor provides all maintenance, material management, and associated system support. The benefits of CLS are similar to direct vendor delivery (DVD) with the added benefit of focusing on system performance metrics such as reliability and maintainability. CLS should be approached as a partnering arrangement between commercial entities and program management and supply support communities, since maintenance, repair, and supply support functions are involved." (Ref. 32) A current example of a CLS initiative is the Joint Strike Fighter program.

- 3rd Party Logistics (3PL): "An organization that manages and executes a particular logistics function, using its own assets and resources, on behalf of another company. Provides physical assets and technology to execute the logistics for companies without that capability or that have decided logistics is not a core competency. These activities include warehousing, transportation, and freight-forwarding." (Ref. 32) An example of a 3PL provider would be Federal Express's Premium Service facility contract with the Defense Logistics Agency.

5. The Defense Distribution Depot

The fifth link in the Naval/Marine Corps aviation logistics supply chain network is the Defense Distribution Depot. The DDD stocks and delivers wholesale DoD supplies to not only Navy and Marine Corps wholesale and retail inventory stockpoints and end-user customers (e.g., Marine squadrons, MALS intermediate maintenance activities). According to the Defense Distribution Center headquarters internet webpage, their mission is as follows:

> The DLA distribution operation responsibilities include receipt, storage, issue, packing, preservation, worldwide transportation, in-transit visibility and redirecting en-route, when required, of all items placed under its accountability by the DLA and the military services. The Defense Distribution Center (DDC) is headquarters to the 22 DLA Distribution Centers located throughout the United States, Europe, Japan, and Hawaii. The 22 sites hold over 3.6 million stock numbers in 325 million cubic feet of storage space and process over 24 million transactions annually. Clothing and textiles, electronics, industrial, general and construction supplies, subsistence, medical material and the military services' principle end items are among the commodities for which the distribution function and personnel are responsible. (Ref. 33)

Not all Defense Distribution Depots are organized the same. In fact, four distribution depots' operations have been outsourced to civilian contractors under the Office of Management and Budget Circular A-76 study concept (Barstow, Warner Robins, Jacksonville and Cherry Point). (Ref. 33) The Defense Distribution Center organizes its depots according to the following strategy:

> All DLA Distribution Centers perform similar functions to service and maintain stock, but their missions can be identified in one of three distinct categories:

- Strategic Distribution Platforms (SDPs) are large facilities that serve as the primary source for the majority of material shipped to customers within their areas of responsibility. Defense Distribution Susquehanna PA (DDSP) has primary responsibility for all DLA customers east of the Mississippi River, in Europe, Southwest Asia, South America, the Caribbean, Canada, Africa and Antarctica. Defense Distribution San Joaquin CA provides this same support to customers west of the Mississippi River, in Asia, the Pacific and Australia.
- Collocated Distribution Centers (CDCs) provide local support to the Services maintenance missions located at or very near each Center. These Distribution Centers may also serve as the primary center for the storage, maintenance and issue of a specific commodity (e.g., Ozone Depleting Substances that require unique facilities or handling procedures).
- Theater Distribution Platforms (TDPs) include Defense Distribution Germersheim, Germany (DDDE) and Defense Distribution Yokosuka, Japan (DDYJ) provide in theater supply support for high demand or critical stock that is needed to support military units in their assigned area of responsibility. By placing stock close to the overseas customers, DLA can provide faster delivery to customers at a lower overall cost. These TDPs increase the Theater Readiness of all services.
- Premium Service Facility is a contractor owned contractor operated (COCO) unique facility providing storage and shipment of high dollar value, low stock level and exceptionally critical stocks for DLA customers. The contractor (Federal Express Memphis Hub) stores these critical items and ships upon demand directly into the commercial overnight delivery system." (Ref. 33)

The locations of the 22 Defense Distribution Centers (DDCs) are:

- Albany, GA
- Anniston, AL
- Barstow, CA
- Cherry Point, NC
- Columbus, OH
- Corpus Christi, TX
- Germersheim, Germany
- Hill, UT
- Jacksonville, FL
- Norfolk, VA
- Oklahoma City, OK
- Pearl Harbor, HI
- Puget Sound, WA
- Red River, TX
- Richmond, VA
- San Diego, CA
- San Joaquin, CA
- Susquehanna, PA
- Tobyhanna, PA
- Warner Robins, GA
- Yokosuka, Japan
- Map Support (Richmond)

As shown in Figure A-1, the DDC also coordinates with the Unites States Transportation Command (USTRANSCOM) and the military services in distributing customer requirements globally. Elements of USTRANSCOM (Military Traffic Management Command, Military Sealift Command, Air Mobility Command, and Civil Air Reserve Force) or military service-unique cargo transportation assets expeditiously transport material requirements to a centralized receiving point (point of debarkation) in the area of operations for a MALS or Marine squadron in a forward deployed area. Figure A-3 shows the locations of the two Air Mobility Command (AMC) air force bases (points of embarkation) that provide the most airlifted cargo transport to overseas Navy/Marine Corps aviation activities and deployed units (Travis CA and Dover DE). AMC flights also originate out of Naval Station Norfolk's Chamber's Field in Virginia. Intra-theater deliveries to the actual operating location of the forward deployed MALS or Marine squadron is usually accomplished by organic military and sometimes contracted civilian or host nation support cargo transportation assets.

6. Inbound Transportation Segments of the Supply Chain

Once the distribution depot (or vendor) ships the material (segment 5 in Figure A-1), it is delivered initially to the regional FISC site or designated supply point of entry supporting the MALS (segment 6 in Figure A-1). One example of this relationship is MCAS Miramar Station Supply Department, which services MALS-16 and MALS-11. Once the MALS receives the inbound shipment of material from the regional FISC site or the supply point of entry (segment 7 in Figure A-1), it then delivers the material to the right customer (segment 8 in Figure A-1).

C. NAVAL/MARINE CORPS AVIATION LOGISTICS SUPPLY CHAIN MAPS

The following figures graphically display the physical locations of the members of the Naval/Marine Corps aviation logistics supply chain network. Figure A-3 displays the locations (in the continental United States) of Marine Aviation Logistics Squadrons, Fleet and Industrial Supply Centers, Naval Aviation Depots and other service

maintenance depots, Inventory Control Points, Defense Distribution Centers supporting Marine aviation. Air Mobility Command air force bases Travis, CA and Dover, DE are also depicted in Figure A-3 for their role in the Naval/Marine Corps aviation logistics supply chain network delivering cargo to overseas and forward deployed units. Figures A-4 and A-5 provide similar maps of the Japan and Hawaii based Naval/Marine aviation logistics activities. Figure A-6 displays the complex network of partnership sites within the FISC San Diego CA claimancy. Of particular note is the fact that Marine Aviation Logistics Squadron 49 (the only fully functional, individually operating reserve MALS) is the only MALS in the Marine Corps operating as a partner site under the FISC San Diego claimancy.

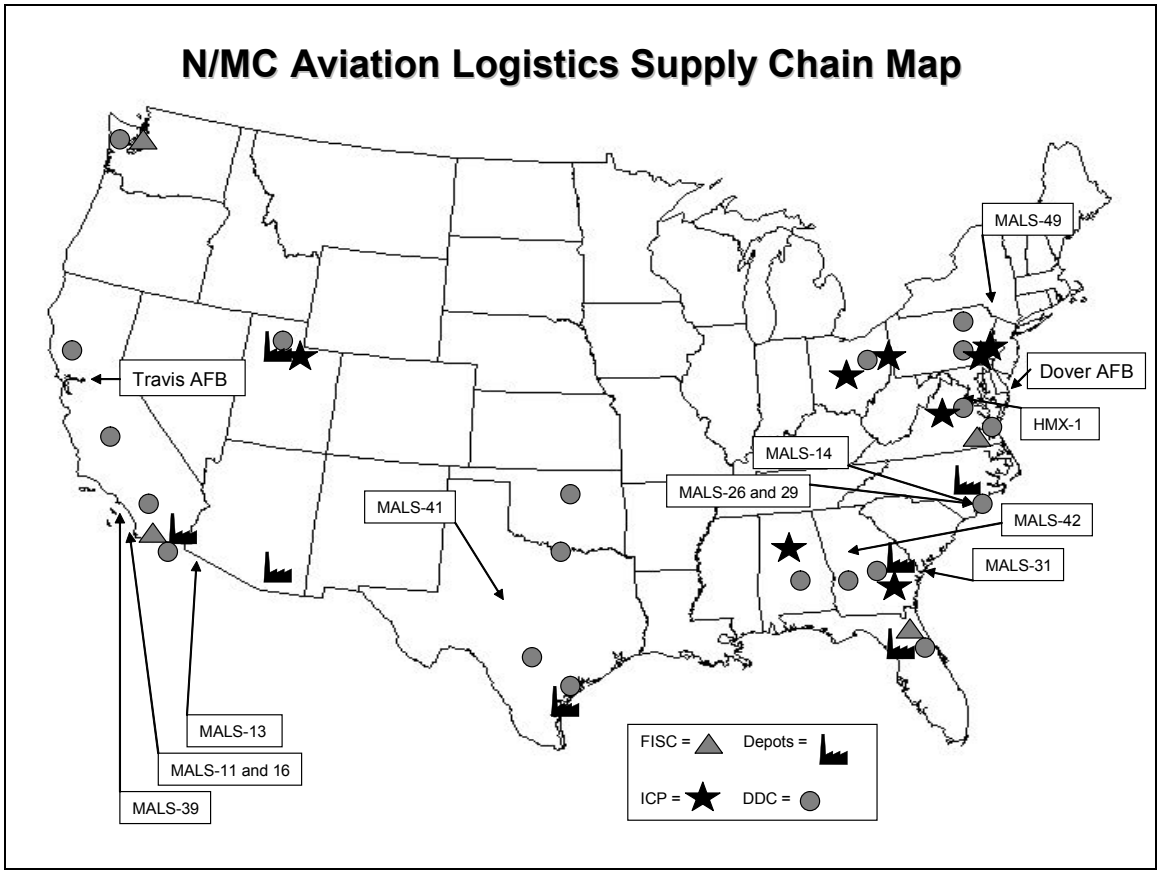

Figure A- 3 Naval/Marine Corps Aviation Logistics Supply Chain Map (CONUS)

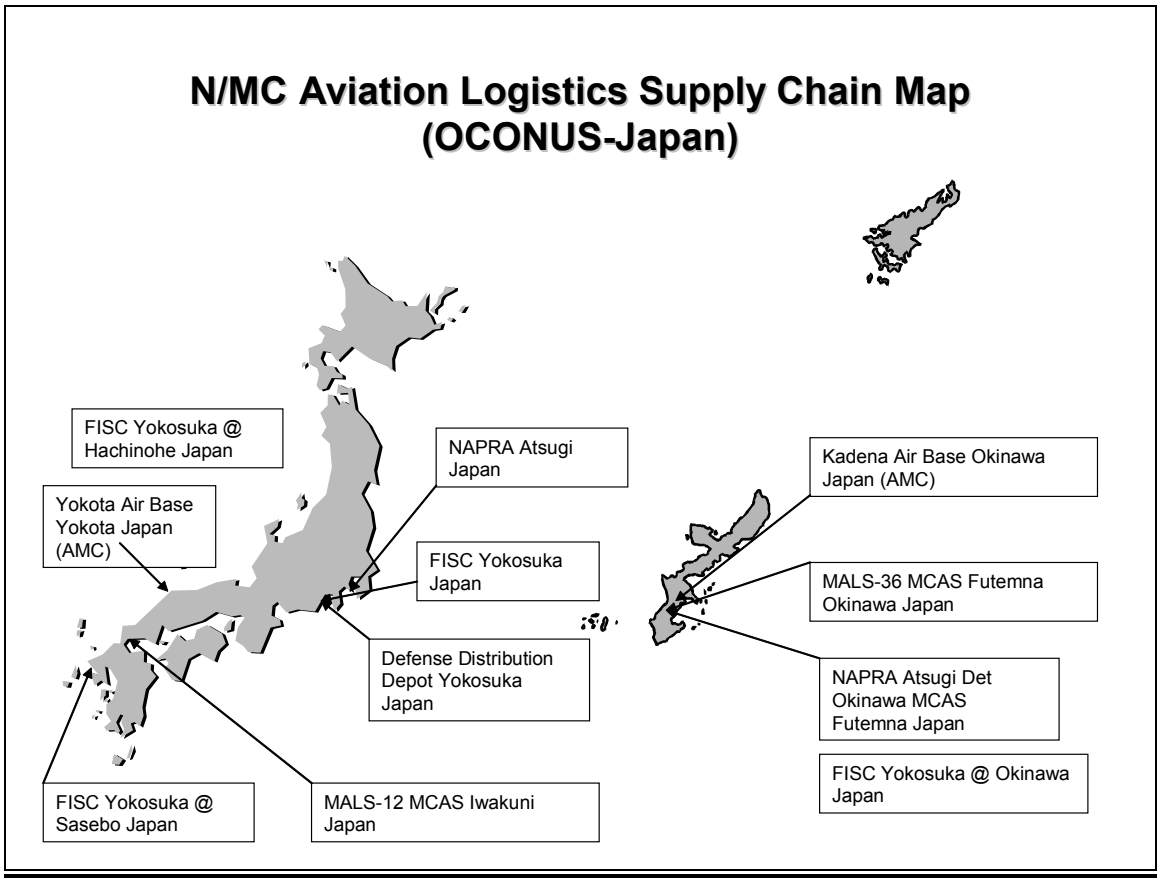
N/MC Aviation Logistics Supply Chain Map
(OCONUS-Japan)
FISC Yokosuka @ Hachinohe Japan
NAPRA Atsugi Japan
Yokota Air Base Yokota Japan (AMC)
FISC Yokosuka Japan
Defense Distribution Depot Yokosuka Japan
FISC Yokosuka @ Sasebo Japan
MALS-12 MCAS Iwakuni Japan
Kadena Air Base Okinawa Japan (AMC)
MALS-36 MCAS Futemna Okinawa Japan
NAPRA Atsugi Det Okinawa MCAS Futemna Japan
FISC Yokosuka @ Okinawa Japan

Figure A- 4 Naval/Marine Corps Aviation Logistics Supply Chain Map (OCONUS-Japan)

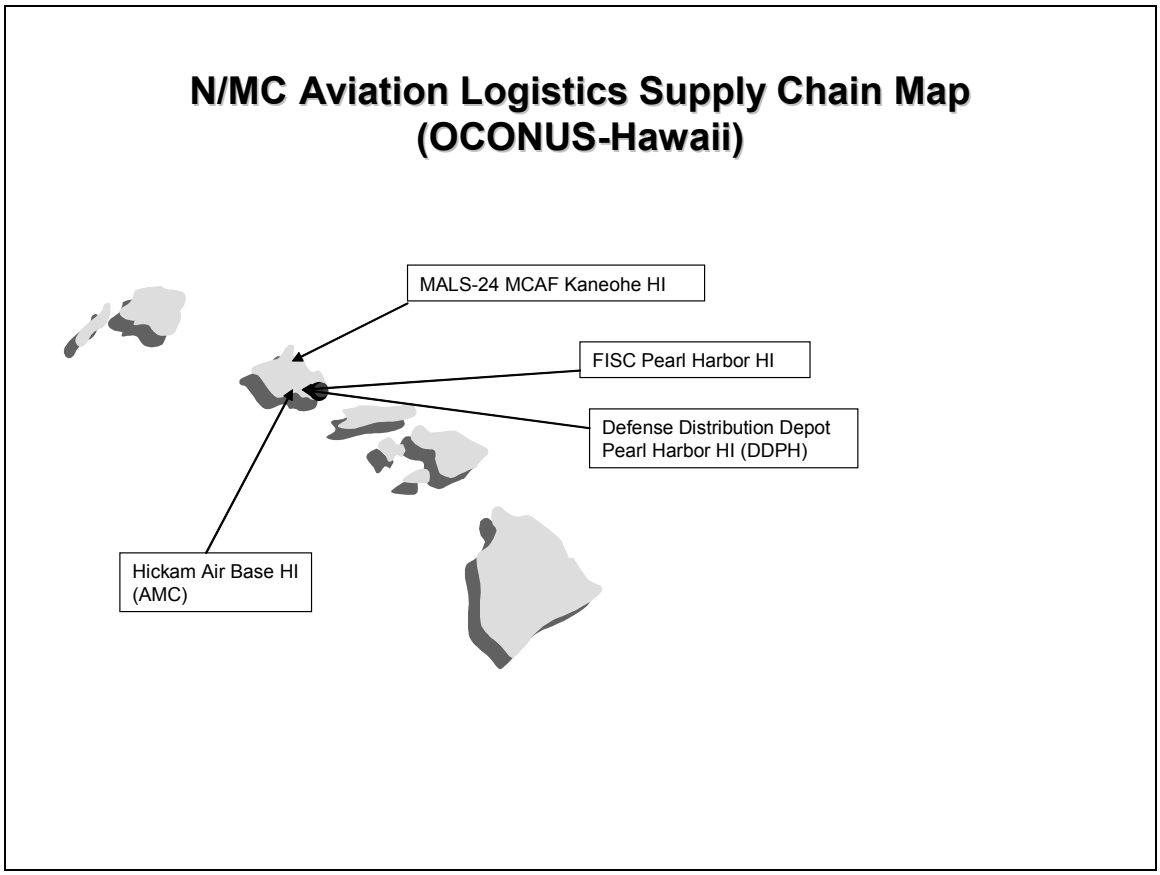

Figure A- 5 Naval/Marine Corps Aviation Logistics Supply Chain Map (OCONUS-Hawaii)

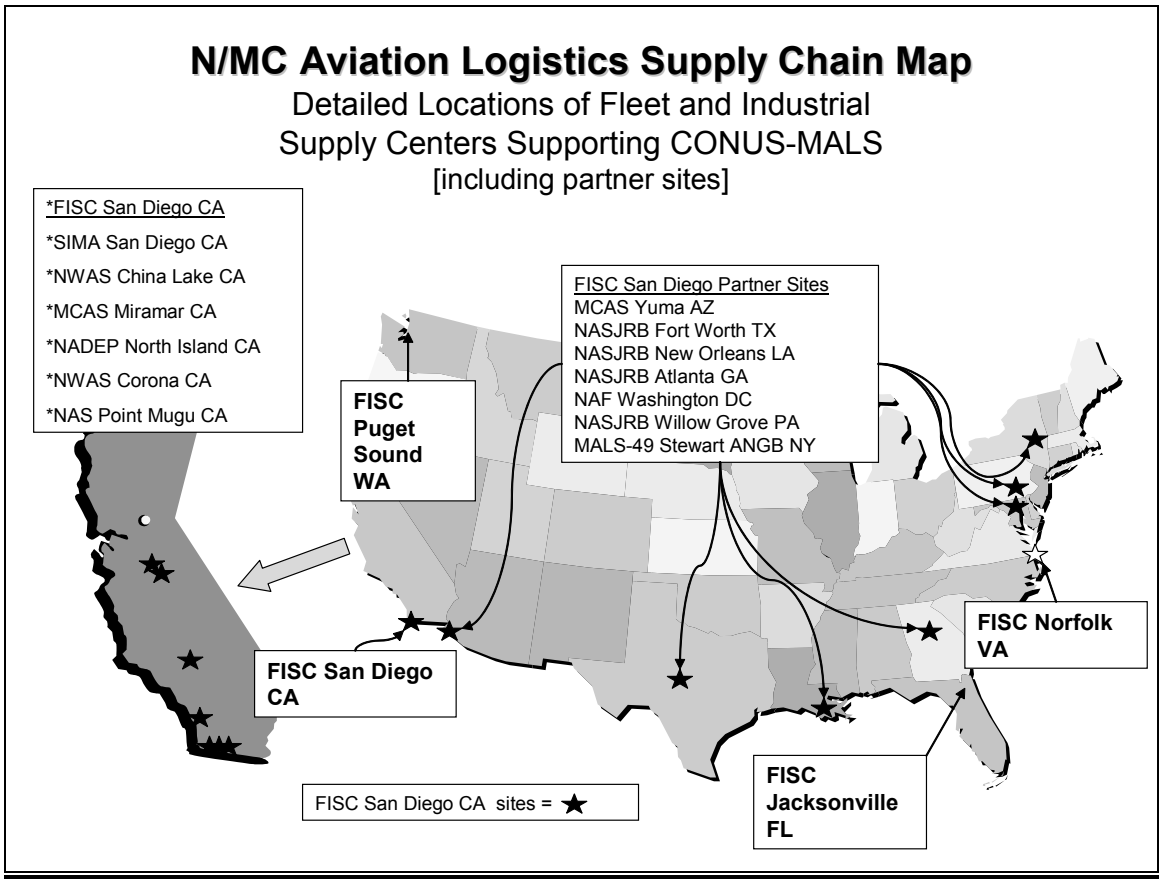
N/MC Aviation Logistics Supply Chain Map
Detailed Locations of Fleet and Industrial
Supply Centers Supporting CONUS-MALS
[including partner sites]
*FISC San Diego CA
*SIMA San Diego CA
*NWAS China Lake CA
*MCAS Miramar CA
*NADEP North Island CA
*NWAS Corona CA
*NAS Point Mugu CA
FISC San Diego Partner Sites
MCAS Yuma AZ
NASJRB Fort Worth TX
NASJRB New Orleans LA
NASJRB Atlanta GA
NAF Washington DC
NASJRB Willow Grove PA
MALS-49 Stewart ANGB NY
FISC Puget Sound WA
FISC San Diego CA
FISC Norfolk VA
FISC Jacksonville FL
FISC San Diego CA sites =

Figure A- 6 Naval/Marine Corps Aviation Logistics Supply Chain Map

(Fleet and Industrial Supply Center Locations-CONUS)

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APPENDIX B.

ADAPTED SCOR MODEL LEVEL 3 DEFINITIONS

In Chapter 2, Supply Chain Management and the MALS, we provided an example of an adapted SCOR level 3 "Deliver" process flow diagram (Figure 2-6). Specifically, this process flow diagram depicted the MALS delivering "stocked products" or "maintain-to-order products" to a Marine squadron. In short, delivering "stocked products" refers to issuing parts off-the-shelf from the MALS inventory to the Marine squadron. This process could just as easily apply to satisfying the MALS's Intermediate Maintenance Activity (IMA) requirements. Delivering "maintain-to-order products" refers to the expeditious repair (EXREP) requisitioning process. An EXREP is a repairable requisition that cannot be filled from the MALS inventory. As a result of this "stock-out" condition, the component ordered must be removed from the aircraft, and inducted into the IMA repair cycle for "expeditious repair." Once the item is repaired, it is then delivered back to the squadron for installation back onto the aircraft. The following figures (B-1 through B-7) provide definitions of the adapted SCOR level 3 subprocess definitions derived from the Level 2 process definition described in Chapter 2 (Figure 2-5):

Adapted MALS SCOR Level 3 Plan Subprocesses

- **P2.1 (Identify, Prioritize, and Aggregate Material Requirements)** = The process of identifying, prioritizing, and considering all sources of demand, as a whole with constituent parts, for material in the supply chain of a product or service.
- **P2.2 (Identify, Assess, and Aggregate Material Resources)** = The process of identifying, evaluating, and considering all material, as a whole with constituent parts, used to add value in the supply chain of a product or service.
- **P2.3 (Balance Material Resources with Material Requirements)** = The process of developing a time-phased course of action that commits material resources to meet material requirements.
- **P2.4 (Establish Detailed Sourcing Plans)** = The establishment of courses of action that represent a projected appropriation of supply resources to meet sourcing plan requirements.
- **P4.1 (Identify, Prioritize, and Aggregate Delivery Requirements)** = The process of identifying, prioritizing, and considering all sources of demand, as a whole with constituent parts, in the delivery of a product or service.
- **P4.2 (Identify, Assess, and Aggregate Material Resources)** = The process of identifying, evaluating, and considering all aspects, as a whole with constituent parts, that add value in the delivery of a product.
- **P4.3 (Balance Delivery Resources with Delivery Requirements)** = The process of developing a time-phased course of action that commits delivery resources to meet delivery requirements.
- **P4.4 (Establish Detailed Delivery Plans)** = The establishment of courses of action that represent a projected appropriation of delivery resources to meet delivery requirements.

Figure B- 1 Adapted SCOR Model Level 3 "Plan-Source and Plan-Deliver" Subprocess Definitions (after Ref. 4:p. 217-218)

Adapted MALS SCOR Level 3 Source Subprocesses

- **S1.1 (Schedule Material Deliveries)** = Scheduling and managing the deliveries of material for a contract, purchase order, or requisition (the requirements for material releases are based on the sourcing plan or other types of material pull signals). Equivalent to initial issue and allowance provisioning.
- **S1.2 (Receive and Verify Material)** = The receipt and acceptance of material deliveries, including all activities associated with receiving, verifying, and accepting material deliveries.
- **S1.3 (Transfer Material)** = The transfer of accepted material to the appropriate stocking location in the supply chain (including all activities associated with repackaging, staging, transferring, and stocking material).
- **S2.1 (Schedule Material Deliveries)** = Scheduling and managing the deliveries of material for the contract; the requirements for deliveries are based on the sourcing plan; this function includes all aspects of managing the contract schedule, including prototypes and qualifications.
- **S2.2 (Receive and verify material)** = The receipt and acceptance of material deliveries for the contract requirements (including all activities associated with receiving, qualifying, verifying, and accepting material deliveries).
- **S2.3 (Transfer Material)** = The transfer of accepted material to the appropriate stocking location in the supply chain (including all activities associated with repackaging, staging, transferring, and stocking material).

Figure B- 2 Adapted SCOR Model Level 3 "Source-Stocked Material and Source-Maintain-to-Order Material" Subprocess Definitions (after Ref. 4:p. 218-219)

Adapted MALS SCOR Level 3 Maintain Subprocesses

- **M1.1 (Schedule Manufacturing Activities)** = The scheduling of operations to be performed in accordance with plans for the manufacture (re-manufacture) of parts, products, and formulations in quantities and planned availability of required material (scheduling includes sequencing and, depending on the factory layout, standards for set-up and run; intermediate manufacturing activities are generally coordinated before scheduling operations performed in producing a finished product).
- **M1.2 (Issue Material)** = The physical movement of material (e.g., raw material, fabricated components, manufactured subassemblies, required ingredients or intermediate formulations) from a stocking location (e.g., stockroom, a location on the production floor, a supplier) to a point of use (issuing material includes the corresponding system transaction; the bill of material or BOM, routing information, or recipe-production instructions determine the material to be issued to support manufacturing/re-manufacturing operations). This could include Shop Replaceable Assemblies (SRAs) and bit-piece-parts received from either Pre-Expended Bins, Phase Kits, Supply Officer's stores, or upstream wholesale suppliers.
- **M1.3 (Manufacture and Test)** = The activities to convert material from the raw or semi-finished state to a state of completion and greater value; the processes associated with the validation of product performance to ensure conformance to defined specifications and requirements. Equivalent to repair by maintainer and test by Collateral Duty Inspector (CDI).
- **M1.4 (Package)** = The activities that containerize completed products for storage or sale to users; packaging in some industries includes cleaning and sterilization.
- **M1.5 (Stage Product)** = The movement of packaged products to a temporary holding location to await movement to a finished goods location (products made to order may remain in the holding location to await shipment per the associated customer order; the actual move transaction is part of the deliver process).

Figure B- 3 Adapted SCOR Model Level 3 "Maintain-to-Stock" Subprocess Definitions (after Ref. 4:p. 219-220)

Adapted MALS SCOR Level 3 Maintain Subprocesses

- **M2.1 (Schedule Manufacturing Activities)** = The scheduling of operations to be performed in accordance with plans for the manufacture (re-manufacture) of parts, products, and formulations in quantities and planned availability of required material (scheduling includes sequencing and, depending on the factory layout, standards for set-up and run; intermediate manufacturing activities are generally coordinated before scheduling operations performed in producing a finished product).
- **M2.2 (Issue Material)** = The physical movement of material (e.g., raw material, fabricated components, manufactured subassemblies, required ingredients or intermediate formulations) from a stocking location (e.g., stockroom, a location on the production floor, a supplier) to a point of use (issuing material includes the corresponding system transaction; the bill of material or BOM, routing information, or recipe-production instructions determine the material to be issued to support manufacturing/re-manufacturing operations). This could include Shop Replaceable Assemblies (SRAs) and bit-piece-parts received from either Pre-Expended Bins, Phase Kits, Supply Officer's stores, or upstream wholesale suppliers.
- **M2.3 (Manufacture and Test)** = The activities to convert material from the raw or semi-finished state to a state of completion and greater value; the processes associated with the validation of product performance to ensure conformance to defined specifications and requirements. Equivalent to repair by maintainer and test by Collateral Duty Inspector (CDI).
- **M2.4 (Package)** = The activities that containerize completed products for storage or sale to users; packaging in some industries includes cleaning and sterilization.
- **M2.5 (Stage Product)** = The movement of packaged products to a temporary holding location to await movement to a finished goods location (products made to order may remain in the holding location to await shipment per the associated customer order; the actual move transaction is part of the deliver process).

Figure B- 4 Adapted SCOR Model Level 3 "Maintain-to-Order" Subprocess Definitions (after Ref. 4:p. 220-221)

Adapted MALS SCOR Level 3 Deliver Subprocesses

- **D1.1 (Process Inquiry and Quote)** = The actions to receive and respond to customer inquiries and request for quotes.
- **D1.2 (Receive, Enter, and Validate Order)** = The actions to receive orders from a customer and enter them in a company's order processing system (orders can be received through phone, fax, or electronic media); examine orders "technically" to ensure an orderable configuration and provide accurate price, and check the customer's credit.
- **D1.3 (Reserve Inventory and Determine Delivery Date)** = The actions to identify and reserve inventory (on-hand and scheduled) for orders and schedule a delivery date.
- **D1.4 (Consolidate Orders)** = The process of analyzing orders to determine the groupings that result in least cost and best services fulfillment and transportation.
- **D1.5 (Plan and Build Loads)** = The actions to select transportation modes and build efficient loads.
- **D1.6 (Route Shipments)** = The actions to consolidate and route loads by mode, lane and location.
- **D1.7 (Select Carriers and Rate Shipments)** = The actions to select carriers by lowest cost per route and rate and tender shipments.
- **D1.8 (Receive Product)** = The activities (e.g., receiving product, verifying, recording product receipt, determining stow location, stowing, and recording location) that a company performs at its warehouses and that sometimes includes quality inspections.
- **D1.9 (Pick Product)** = The activities (e.g., including retrieving orders to pick, determining inventory availability, building the pick wave, picking the product, recording the pick, and delivering the product to shipping) in response to an order.

Figure B- 5 Adapted SCOR Model Level 3 "Deliver Stocked Product" Subprocess Definitions (after Ref. 4:p. 222-223)

Adapted MALS SCOR Level 3 Deliver Subprocesses

- **D1.10 (Load Vehicle, Generate Shipping Documents, and Ship)** = The tasks of placing products on vehicles; generating the documentation to meet internal, customer, carrier, and government needs; and sending the product to the customer.
- **D1.11 (Receive and Verify Product at Customer's Site)** = The process of receiving the shipment at the customer's site and verifying that the shipped order is complete and the product meets quality requirements.
- **D1.12 (Install Product)** = The process of preparing and installing the product at the customer's site (the product is fully functional after completion).
- **D1.13 (Invoice and Receive Payment)** = The actions to send a signal to the financial organization that the order has been shipped and that the billing process should begin (payment is received from the customer within the payment terms of the invoice).
- **D2.1 (Process Inquiry and quote)** = The actions to receive and respond to customer inquiries and requests for quotes.
- **D2.2 (Receive, configure, enter, and validate order)** = The actions to receive orders from a customer and enter them into a company's order processing system (orders can be received through phone, fax or electronic media), configure product to the customer's needs based on standard available parts or options, examine order to ensure an orderable configuration and provide accurate price, and check customer's credit.
- **D2.3 (Reserve resources and determine delivery date)** = The actions to identify and reserve inventory or planned capacity for orders and schedule a delivery date.
- **D2.4 (Consolidate orders)** = The process of analyzing orders to determine the groupings that result in least-cost and best service fulfillment and transportation.

Figure B- 6 Adapted SCOR Model Level 3 "Deliver Stocked Product (continued)" Subprocess Definitions (after Ref. 4:p. 223-224)

Adapted MALS SCOR Level 3 Deliver Subprocesses

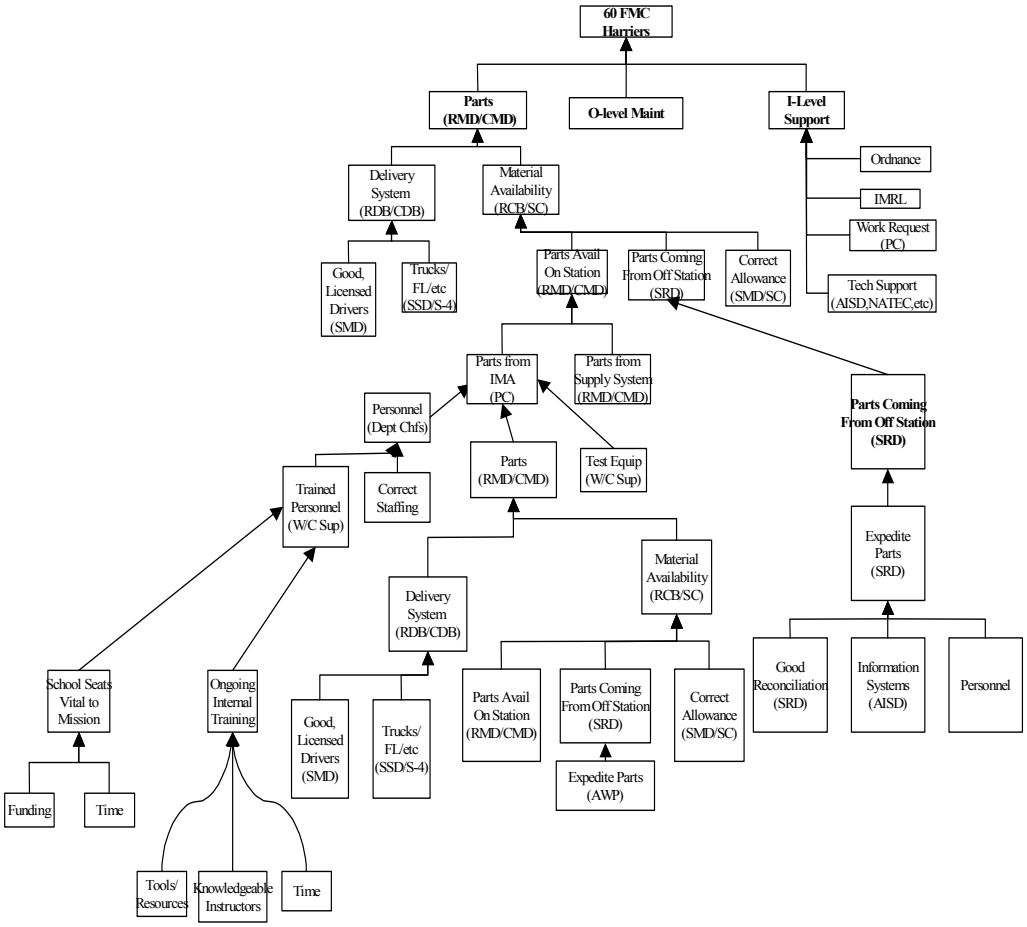
- **D2.5 (Plan and build loads)** = The actions to select transportation modes and build efficient loads.
- **D2.6 (Route shipments)** = the actions to consolidate and route loads by mode, lane and location.
- **D2.7 (Select carriers and rate shipments)** = the actions to select carriers by lowest cost per route and rate and tender shipments.
- **D2.8 (Pick staged product)** = The activities (including retrieving orders to pick, verifying inventory availability, building the pick wave, picking the product, recording the pick, and delivering product to shipping) performed in the distribution center in response to an order.
- **D2.9 (Load vehicle, generate shipping documents, and ship)** = The tasks of placing product on vehicles; generating the documentation to meet internal, customer and government needs; and sending the product to the customer.
- **D2.10 (Receive and verify product at customer's site)** = The process of receiving the shipment at the customer's site and verifying that the shipped order is complete and the product meets quality requirements.
- **D2.11 (Test and install product)** = The process of preparing, testing, and installing the product at the customer's site; the product is fully functional after completion.
- **D2.12 (Invoice and receive payment)** = The actions to send a signal to the financial organization that the order has been shipped and that the billing process should begin (payment is received from the customer within the payment terms of the invoice.

Figure B- 7 Adapted SCOR Model Level 3 "Deliver Stocked Product (continued)" Subprocess Definitions (after Ref. 4:p. 224-225)

APPENDIX C.

MAG-14 AIRCRAFT READINESS

FUTURE REALITY TREE



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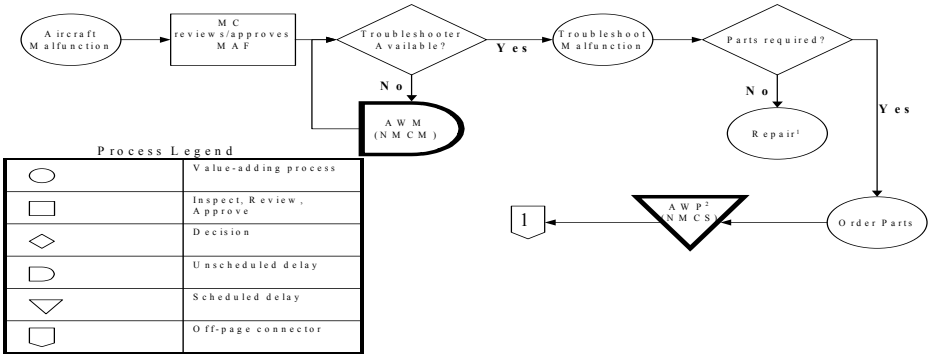
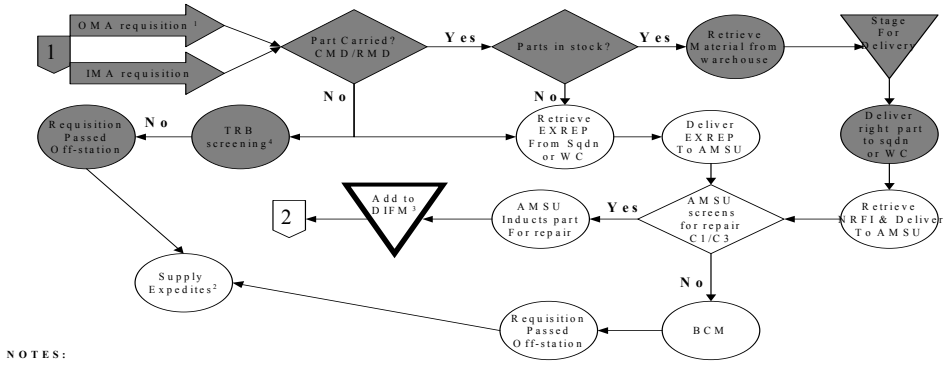
APPENDIX D.

PROCESS FLOW DIAGRAMS



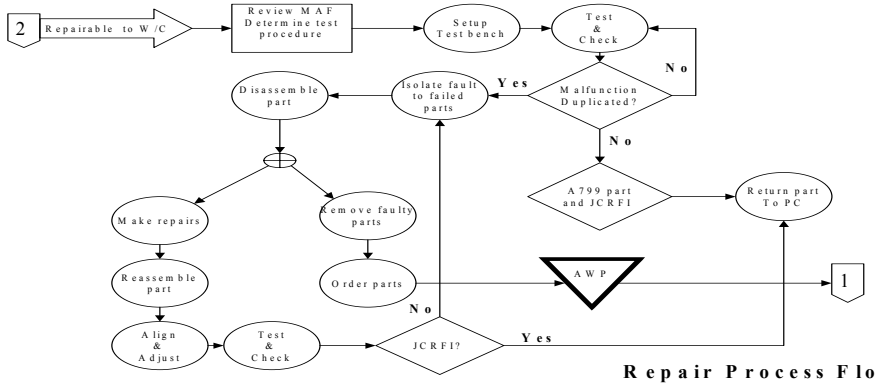
NOTES:
1. Parts available from PEB or item is inducted on work request to IMA.
2. Retrograde parts await pickup by Supply.

Repair Process Flow OMA



NOTES:
1. Exchange advice-coded (e.g., 5G) requisition submitted via OMA/IMA NALCOMIS interface.
2. Expedite DTO/stock dues and request supply assistance from other MALS.
3. DIFM is IMA WIP.
4. Decision on requisition depends on TRB results (e.g. cancel and reorder).

Repairable/Consumable Process Flow (Simplified) Supply



Repair Process Flow IMA

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APPENDIX E.

MALS-14 VISION STATEMENT

MALS-14 VISION

Every MALS-14 Dragon has a clear understanding of the MALS focus and each is a vital participant in a total team effort toward MALS-14 being recognized as the best large logistics activity in the Department of Defense.

MAG-14 enjoys high quality support from MALS-14. MALS-14 works very closely with the squadrons of MAG-14 as an integrated logistics team.

Dragons possess a deep sense of professional DRAGON PRIDE and esprit as members of the MALS-14 team.

FOCUS

"NULLI SECUNDUS"

Second to none, MALS-14 is formally recognized for logistics excellence in 2001.

MALS-14 drives the MAG-14 increase in aircraft readiness that surpasses 80 percent full mission capable and 80 percent mission capable rates at the turn of 2001 to 2002, and beyond.

AIRCRAFT READINESS

"MALS-14, Second to None,
80 – 80 Readiness through 2001"

MALS-14 Dragons take care of each other with "people programs" that are measurably among the best in the Marine Corps.

DRAGONS are committed to:

CORE VALUES

Core Values are the guide of all actions, decisions, and work methods. Doing the right thing is consistently expected in execution of mission and in personal conduct, both on and off duty.

BALANCING PEOPLE AND PURPOSE

MALS-14 drives the aircraft readiness of MAG-14 – this is the purpose of the MALS. This mission will be pursued in harmony with the needs of the people. Dragons know they will be taken care of and thus are excited to be a part of the team — a team that includes Dragon families.

REINFORCING EXCELLENCE

Dragons are immediately rewarded for hard work, for advancing the MALS goal, and for adhering to values. Dragon awards emphasize team action and recognize families and supporting agencies.

A RELENTLESS POSITIVE APPROACH

Starts with leaders setting a positive example, … expects all Dragons to say "yes--we can," … fosters proactive thinking to prevent (not react to) problems, … punctuated by positive results.

TOTAL PROFESSIONAL COMPETENCE

A never-ending campaign to increase military and technical skills begins with perfecting the fundamentals of MALS core functions. As a "learning organization," MALS-14 employs "Theory of Constraints" management methods. Open communications, information sharing, and continuous feedback enables team growth.

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